


Liggins Education Network for Science

# Student – Scientist Mentor Programme 2011

**From Student to Scientist,  
Steps on a Journey**

Student Name: \_\_\_\_\_



*encourages you to:*

- use creativity
- persevere
- apply what you know and
- communicate.



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# Student – Scientist Mentor Programme 2011

Congratulations on your acceptance into the Student - Scientist Mentor Programme 2011.

The programme is based on the CREST (Creativity in Science and Technology) programme, administered in New Zealand by the Royal Society. This is an international awards programme that promotes creativity, perseverance and application of knowledge in a non-competitive format. After CREST assessment has been completed, all students will enter their projects in the **NIWA Auckland Science and Technology Fair**, which is a competitive environment.

Being awarded a place in the LENSscience Mentor Scholarship is a significant privilege. That privilege comes with the challenge to you of meeting the very high expectations that will be set along the way. Although the expectations are high, there is significant support for you from both your school and the LENSscience. This means that while you will find the programme challenging, as long as you are making a commitment to the programme and doing your best to achieve the goals that are set for you, there will be support for you in your endeavours.

## **Programme Goals:**

To encourage students to:

- develop the skills and attitudes associated with the process of scientific research, (including questioning, creativity, planning, problem solving, persistence, and communication)
- extend their understanding of aspects of scientific knowledge relevant to their project
- strive for excellence in all that they undertake
- use goals to develop time and project management skills
- develop effective relationships with mentors and through this learn about scientific research and its role within society

*Te manu e kai i te miro non ate ngahere.*

*Te manu e kai i te mataurangi non ate ao.*

*The bird that feeds on the miro berry has the bush at its domain.*

*The bird that feeds from learning has the world at its domain*

***“People do not decide to become extraordinary. They decide to accomplish extraordinary things.” Edmund Hillary***

# Participants

## Student – Scientist Mentor Programme 2011

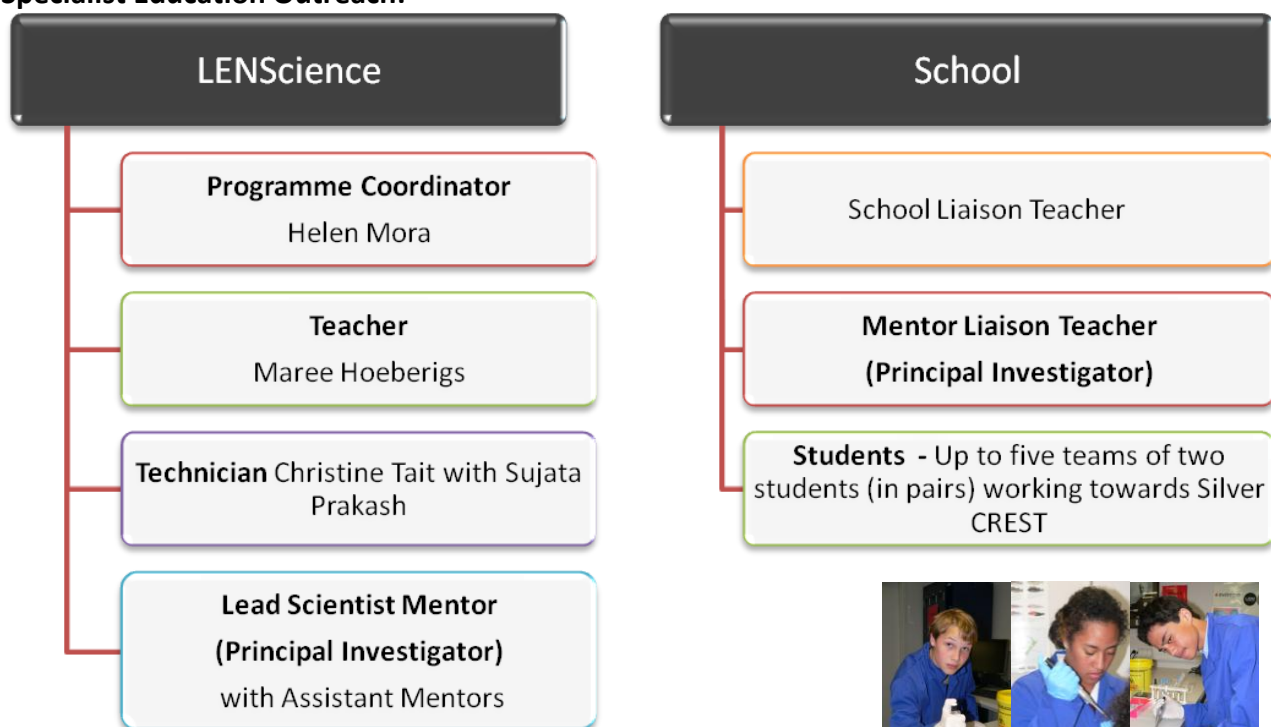
### Participant Schools

<u>School</u>	<u>School Liaison Teacher</u>	<u>School Lead Scientist</u>
James Cook High School	Ms Padmasiri	Dr Kristin Connor
Kelston Boys High School	Mr Summerhays	Dr Matthew Barnett
Kelston Girls' College	Ms Guiss	Dr Sarah Gibbs Dr Felicia Low
Mount Maunganui College	Ms Burggraaf	Prof Michael Heymann
Onehunga High School	Dr Krzyzosiak	Dr Mark Green
Saint Kentigerns College	Dr Martin	Dr Deb Sloboda
Tamaki College	Mr Major	Dr Denise Greenwood
Tangaroa College	Ms Folkard	To be confirmed
Te Kura Kaupapa Maori o Te Raki Pae Whenua		

### LENScience Teachers:

- Ms Jacquie Bay      Director, LENSscience, Liggins Institute
- Ms Helen Mora      Programme Coordinator, LENSscience, Liggins Institute

### Specialist Education Outreach:



- Mrs Jessie McKenzie      The Royal Society of New Zealand



### **The Responsibilities of the Student:**

- From the school research theme initiate the team project idea; develop this into a testable hypothesis; plan, carry out and report on their findings.
- To keep an accurate log of their work, including records of all interactions with teachers and mentors.
- To ensure that they meet the milestones on time and complete all work to the best of their ability.
- To initiate support when required by asking appropriate questions and seeking advice.
- To show appropriate respect for the support that they are receiving from teachers and mentors.
- To present their work for CREST assessment; the regions Science and Technology Fair; and at the LENSscience Student-Scientist Mentor Awards.

### **The Role of the LENSscience Teacher Mentor:**

- To provide workshops and support meetings for students at key research stages.
- To provide guidance to the school programme liaison teachers and provide support, particularly, in the initial stages, for schools new to the programme.
- To monitor student progress via the school liaison teacher.
- To ensure that the level of work that students are undertaking is appropriate to the CREST Award for which they are entered.
- To complete the final assessments of all projects.

### **The Role of the School Programme Liaison Teacher (Principal Investigator):**

- To monitor student progress by meeting with students on a regular basis to ensure that the research is being completed to the standard required for CREST.
- To support students in the development of their skills required to allow them to make appropriate progress towards their milestones.
- To ensure the wider school community, including the students other teachers, are aware of the work these students are undertaking through LENSscience at the Liggins Institute
- To ensure that LENSscience staff are aware of any school activities that may affect the student's progress during the year.

### **The Role of the LENSscience Technician:**

- To provide technical support for students throughout their projects
- To assist students in learning new techniques required for their projects

### **The Role of the School Lead Scientist Mentor (Principal Investigator):**

- To direct questions to the student teams that encourage them to develop their research questions
- To assist students in accessing information that may be relevant. This may include:
  - providing copies of relevant papers to students (extension is a key goal);
  - suggesting possible sources of information;
  - encouraging students as they learn to access academic literature;
- Where appropriate and possible, to provide assistance to students in learning about techniques that are appropriate to their projects. This may be via the classroom technician.
- To assist students in the development of their Investigation Action Plan.
- To consult with the school programme liaison teacher on approval of research projects.
- To provide on-going feedback throughout the project relating to data collection, data analysis and reporting.

# Student - Scientist Mentor Programme 2011

## Year 1 Student Timetable

Event	Date	Time	Location
<b>Getting Started 2010</b> Planning and Preparation	Thursday 2 <sup>nd</sup> December Friday 3 <sup>rd</sup> December	9:00am – 3:00pm	Liggins Institute
During the school holidays, from Monday 23 <sup>rd</sup> to Friday 28 <sup>th</sup> January (9:00am – 4:00pm), you can arrange to come into the classroom for assistance with gathering background information for your project, developing your method and learn techniques if required.			
<b>Term One 2011: Data Gathering</b>			
<b>Workshop 1:</b> Develop plan and meet scientist mentor	Week 3 14 <sup>th</sup> and 15 Feb.	9:00am – 3:30pm	Liggins Institute
<b>LENScience Teacher Progress Check</b>	Week 6	To be confirmed	At your school
<b>Submit</b> final plans to Liggins for approval.	Week 9	By 9:00am	Submit via email
<b>LENScience Teacher Progress Check</b>	Week 10	To be confirmed	At your school
<b>Support days.</b> Students <b>may</b> come into the classroom to meet with mentors, finalise data collection etc – <u>if required</u> . All <u>final data</u> must be collected by the end of holidays.	1 <sup>st</sup> week school holidays Monday 18 <sup>th</sup> April to Wednesday 20 <sup>th</sup> April	Lab and help available from 9:00am – 4:00pm each day	Liggins Institute
<b>Term Two: Data Analysis, Conclusions and Reports</b>			
<b>LENScience Teacher Progress Check</b>	Week 2	To be confirmed	At your school
<b>Workshop 2:</b> Learn how to analyse data and write conclusions. Report writing overview.	Week 4 16 <sup>th</sup> and 17 <sup>th</sup> May	9:00am – 3:00pm	Liggins Institute
<b>LENScience Teacher Progress Check</b>	Week 10	To be confirmed	At your school
<b>Support days and Preparing for Science Fair and Final Submissions.</b> Meeting with your mentor, practising doing interviews, preparing for your presentations.	1 <sup>st</sup> week school holidays Monday 18 <sup>th</sup> July to Wednesday 20 <sup>th</sup> July	Arrange with mentor	Liggins Institute
<b>Term Three: Science Fair, CREST submissions and Awards</b>			
<b>Assessment submission</b> This is your silver CREST report.	Week 1 By Friday 5 <sup>th</sup> August		Submit via email
<b>CREST final assessment interviews</b> <i>Each team has an interview with the assessor – approx 1 hour per student.</i> <b>Putting the boards together.</b>	Week 3	To be confirmed	At the school
<b>Regional Science Fair Judging Day</b>	To be confirmed	To be confirmed	To be confirmed
<b>Regional Science Fair Awards Evening</b>	To be confirmed	To be confirmed	To be confirmed
<b>LENScience Awards Evening.</b> This is a time when your mentors, families, and representatives from your schools are invited to the Liggins Institute. Science Fair boards are on display and each team will make a 2-3 minute presentation on the project. CREST and LENScience awards will be presented.	To be confirmed	Presentations at 5:45pm. Rehearsals for students start at midday.	To be confirmed

# Email Protocol for Students

Email is the form of communication that we will use – it is your responsibility to check your emails regularly and make sure that your school or home email inbox is not too full.

**Save** the emails to a folder on your computer and **delete** from your sent items and inbox.

**All email communication must be recorded in your log book.**

**Emails sent to teachers and mentors are different to emails that you send to your friends!**

**Below are guidelines that you are expected to follow when sending email messages.**

- **Subject –**  
Always insert a brief subject heading – e.g. DNA extraction technique
- **How to address mentors:**  
Address your mentor formally - as you would your teacher.  
E.g. Dear Ms Mora.....  
As you get to know them better, you may find that this changes to a less formal greeting, but please ensure that you follow the example given by your mentor. You do not initiate a less formal greeting.
- **The message:**  
Keep your message brief  
Be specific in your questions - ensure that you are clear about what you are asking  
Make sure that you spell check your message before sending  
Do not use txt language in your message  
Remember it is up to you to do the work and the project is yours – your mentor is there as an advisor only.  
**Bold or CAPITAL LETTERS** in an email are the equivalent to shouting at a person - please do not use these in your message.
- **Adding Attachments:**  
Once you get to the point of having a protocol or results ready, you may find that it is good to send a copy to either your teacher mentor or scientist mentor. Make sure that the document is clearly labelled and that your message indicates what you want the mentor to look at within the document. **Highlighting a section within the document can be useful.**
- **Ending your email:**  
Appropriate endings include: thank you; thanks; regards; kind regards.
- **Frequency of emails and time of reply:**  
It is neither polite nor responsible to bombard your teacher or mentor with large numbers of emails.  
Think carefully about what you need to ask, send one clear and concise email.  
Your mentors are very busy people. There may be several days between the time that you send the message and the reply. However, I do expect you to reply within one day to emails from your teacher or mentor.  
  
Please let your teacher and mentor know if you are going to be away for a period of time.
- **Problems with email:**  
If for some reason you are having problems sending or receiving emails, please contact me and I will send a message indicating this to your mentor and take you through possible solutions.

## Student Guidelines

- You will work as part of a team which consist of **two** students.
- You will need to keep a **log book** that records everything that you do even thinking time! Your log book will have all your rough notes, brainstorms, trials, successes and failures in it. It is a bit like a diary of your project. Fill it in each and every time you work on your project.

### **TASK 1: SETTING UP**

- Set up your [log book](#).
- Glue any handouts into the first pages of the book – or create a small folder for your log book, placing handouts in the front of the folder.

### **TASK 2: INVESTIGATION ACTION PLAN**

#### **PART A: Project Idea**

- Each school has ONE central topic or research theme. Do some background research on this topic. Brainstorm some ideas for your schools investigations – record in your logbook!!!
- Refine these to create your team’s investigation idea.
- Evaluate whether your project is feasible - can you do the project in a reasonable length of time with your skills and the resources available?
- Evaluate whether your project will meet the requirements of CREST – is there an aspect of creativity?
- Gather information on your idea from a wide range of sources. Use the resource sheets [Gathering and Recording Background Information](#) and [Referencing Diary](#) to ensure you gather and record your research so that it can be used and referenced correctly in your report.
- Complete “Part A: Project Idea” on your [Investigation Action Plan](#)

#### **PART B: Exploratory Activities**

- Find out **how** you are going to do the experiments that you need to do for your investigation - what tests and techniques will be useful, how do you do the tests, is the equipment available, are there any safety issues?
- If your idea involves animals and/or humans then you may require [Animal](#) or [Human Ethics](#) approval – this must be applied for **BEFORE** you begin your investigation.
- To complete your investigation successfully you **must** manage your time! Complete the [timeline template](#) provided or, alternately, design your own! Enter onto your timeline when you will carry out activities you have identified from your planning. Remember to mark down key dates e.g. school events, holidays, sports tournaments.
- Complete “Part B: Exploratory Activities” on the [Investigation Action Plan](#).

<b>MILESTONE ONE:</b> The LENSscience teacher will meet with you and your teacher to discuss your <b>Investigation Action Plan</b> in <b>week 6</b> .
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#### **PART C: Detailed Project Plan**

- In your plan you are trying to define the following:
  - Aim: A clear statement of intent
  - Definition of variables. Remember! For an investigation to lead to a valid conclusion the variables will need to be rigorously controlled and repeats will need to be carried out. Your investigation must include adequate trials to allow you to conduct the necessary statistical validity tests required. Use “Part C: Detailed Project Plan” on the [Investigation Action Plan](#).
- Ensure that all of the following are completed ready to be sent to Wellington by your LENS teacher.



**MILESTONE TWO:** Submit **Investigation Action Plan** and [CREST Project Approval Form](#) to LENSscience teacher Monday 14<sup>th</sup> March.

### **TASK 3: DATA GATHERING**

- Conduct trial experiments if necessary to determine:
  - How to keep variables constant
  - The variables that you will keep constant and their value
  - The range over which you will alter the selected variable.
- Develop your skills in the techniques that you require
- Develop and organise access to the equipment that you require
- **Gathering data:** Carry out your investigation, recording all relevant data accurately and clearly. Make sure you collect sufficient data to allow you to draw a valid conclusion.

### **MILESTONE THREE:**

Present your data for evaluation. Evaluate the quality of the information gathered and its degree of relevance and discuss this with your teacher/mentor. To be completed by 29<sup>th</sup> April.

### **TASK 5: DATA ANALYSIS and REPORTING**

- Present your data in tables and graphs
- Decide what trends and patterns can be seen in your data.
- Analyse your data using statistical tests to look at the level of reliability.
- Decide what your data tells you about your hypothesis. Did your data support your hypothesis?
- What does the data tell you about the answer to your original question?
- Write a conclusion for your investigation. This must link your results to your original question and take into account any limit of accuracy.
- Write a discussion in which you explain the relevance of what you have found out and evaluate the validity and reliability of your results.
- If you think that there are any ways in which you could improve your project, mention them here.

### **MILESTONE FOUR:**

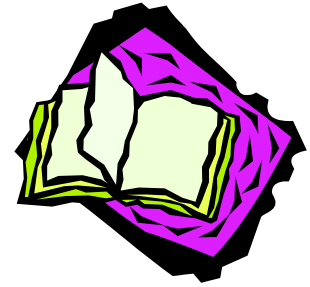
Discuss your analysis and conclusion with your teacher/mentor.  
Present your draft report for evaluation.  
This is to be done by the Friday 5<sup>th</sup> August, week 1 Term 3.

### **MILESTONE FIVE:**

Hand in completed report in printed and electronic form by the 10<sup>th</sup> August.  
Meet with LENSscience assessor Week 3 Term 3.  
Prepare board for Auckland Science Fair - date to be confirmed.  
Prepare oral presentation and power point for LENSscience Awards Evening - date to be confirmed.

# Log Books

Log books are an essential part of every project.  
They will accompany your project when it is displayed.



## Log books are.....

### A diary

- to keep your thoughts and ideas – write as you go
- to plan how you will use your time
- to keep a record of what you did and when

### A workbook

- to record your method, your mistakes, your improvements, the things you need to do and the things you plan to do

### A notebook

- to record notes from conversations with teachers, consultants, experts, and ideas from friends and family.

### A research book

- to record information that you find out from books, internet, libraries.....
- to record where your research came from
- refer to [Referencing Diary](#)

### A record book

- to write all your raw results from all your trials, your final experiments, surveys and tests.

### A draft book

- to write out drafts of all your final notes and then edit them.



## Log books are not.....

- always neat and tidy
- written at the end of your project

Log books have dates.  
Write as you go -  
Don't leave it to your memory!!!

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# Gathering Background Information on your Topic

Now you have decided on a topic, you need to gather background information and record this in your **LOG BOOK**. Make sure that as you collect your information, YOU RECORD WHERE YOU FOUND IT! This is really important as you will have to create a reference list and bibliography for your final report.

## What is needed for Referencing?

Citing (or listing) of references is the way in which scientists show that they have searched the published literature to find out what is already known about the topic of investigation and recognise the work of others. There are two aspects to referencing in your report:

- a. The reference list at the back of your report showing all references that you have used.
- b. Citations or quotes within the text of your report which show where you have obtained specific information that you are using in the report.

## Creating the Reference List

### For Books:

This is written in the form: author, date of publication, title, and publication information.

- **Author(s)** Write the family name then initials for all authors. Use commas to separate authors. Finish with a full stop, e.g. Selinger, B.
- **Date of publication.** Give the year the work was published in brackets, e.g. (1989).
- **Title.** This is in *italics* with additional information in brackets to enable identification, e.g. *Chemistry in the Marketplace* (4<sup>th</sup> ed.).
- **Publication information.** Give the name of the city, then a colon followed by the name of the publisher written as briefly as possible, e.g. leave out terms like *publishers, Co.* e.g. Sydney: Heinemann.

This goes together as follows:

Selinger, B. (1989). *Chemistry in the Marketplace* (4<sup>th</sup> ed.) Sydney: Heinemann

### For Periodicals:

This is written in the form: author, date of publication, article title, journal title, and publication information.

- **Author(s) and date of publication.** This is the same as for books, e.g. Becker, L.J. & Seligman, C. (1981).
- **Article title.** This is in normal type, e.g. Welcome to the Energy Crisis.
- **Journal title and publication information.** Give the journal title in full in *italics*. Next give the volume number but do not use "Vol." before the number. Finally give the page numbers. Use "pp" before the page numbers in newspapers and magazines but not in references to journal articles, e.g. *Journal of Social Issues*, 37, 1-7.

This goes together as follows:

Becker, L.J. & Seligman, C. (1981). Welcome to the Energy Crisis. *Journal of Social Issues*. 37, 1-7

### For the Internet:

Where you use information from the Internet e.g. text, photographs, maps or anything else you should provide three pieces of information. These are:

- the web address
- what organisation or person is in charge of the web site. This gives some idea of how authoritative the site is
- the date you accessed the web page

This is written in the form:

[www.usgs.com/catastrophism/asaro](http://www.usgs.com/catastrophism/asaro) (United States Geological Society, 12.02.02)

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# Referencing Diary

Every time you find some information that will help you towards your project, you should record the source of the information so that you can create an accurate bibliography in your project report. Use the table on this page to record your references as you go. There are some examples for you.

Books that I have used				
Title	Author	Publisher	Year of publication	What I found out about from this reference.
e.g. Science World 10	Hook P., Stannard P., Williamson K.	Macmillan	1999	Information on how to test the strength of a hair fibre.

For the internet sites I have used	
Address	What I found out about from this reference.
http://www.bbc.co.uk/sia/home.html	Information on the properties of materials.

Articles that I have used				
Title of the Article	Author	Where I found the article (Name of magazine, journal, newspaper....)	Year of publication	What I found out about from this reference.

Name of Person	Position	Date of conversation	What I found out about from this conversation.

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# Investigation Action Plan

Complete this template - this form will be sent to Wellington with your CREST application for project approval.

## PART A: Project Idea

### Project Idea

What is your research question / investigation topic?

### Background Information

What do I know about this topic?

What do I need to find out about before I can plan my investigation?

What have I found out about this topic that will be useful? **Remember to record your references in your reference diary!!!!!!**

## PART B: Exploratory Activities

### Tests and Techniques – how am I going to do my experiments?

Find out what tests and techniques will be useful for your investigation. E.g. if you need to measure heart rate – how do you do this and what equipment will you need to do this?

Equipment / Facilities that I would require

Tests and techniques that might be useful

Identify what you will need to learn / work out how to do / get help with.....

Who are the people I will need to contact to get equipment / learn how to do the tests etc?

**Safety!** Are there any safety considerations? If so – list them here.

Does this project require Animal Ethics Approval? Yes / No

Does this project require Human Ethics Approval? Yes / No

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**PART C: Detailed Project plan – write this very clearly so that another person could carry out your investigation without your help.**

There are two examples of student plans that are appropriate for silver CREST in Appendix VI

Aim:
------

Hypothesis:
-------------

Variables	
Independent variable (What I will change)	
Dependent variable (What I will measure to find the answer to my question)	
Controlled Variables (What I will keep the same to make sure I have a fair test)	

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## Method:

Use a series of numbered points to write your step by step plan.

Remember to make sure that you have enough repeats to be certain of your findings in the end.

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
7. ....



# Use of Animals in Science Projects

Animal Ethics Approval is required for use of animals in school investigations for Science and Technology Fairs and CREST Awards. You may observe an animal without ethics approval, but as soon as you manipulate the animal or its environment, you must apply for ethics approval.

## What is defined as an animal?

The definition of an animal includes:

- All vertebrates (animals with backbones).
- Lower vertebrates (amphibians, fish);
- A small number of invertebrates (octopus, squid, crab, lobster, crayfish); and
- Mammalian foetuses, avian or reptilian pre-hatched young in the last half of gestation or development and marsupial pouch young. This acknowledges that foetuses and embryonated eggs may be sensitive to noxious stimuli.



What animals can you use without ethics approval?

- Invertebrates other than those listed above – e.g. ants, slaters, worms.....



What can I do with an animal without ethics approval?

- You can observe an animal in its natural environment

**If you are going to manipulate an animal – you need animal ethics committee approval**

## What is manipulation of an animal?

"Interfering with the normal physiological, behavioural, or anatomical integrity of the animal by deliberately -

- Subjecting it to a procedure which is unusual or abnormal when compared with that to which animals of that type would be subjected under normal management or practice and which involves -
  - Exposing the animal to any parasite, micro-organism, drug, chemical, biological product, radiation, electrical stimulation, or environmental condition; or
  - Enforced activity, restraint, nutrition, or surgical intervention; or
  - Depriving the animal of usual care..."

## What do I need to provide for my animals?

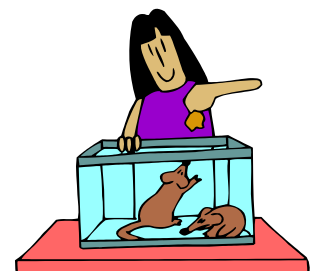
You must be able to show:

- that you know how to care for your animals
- that the animals will not be harmed in any way by the work that you do with them
- that your animals have the five freedoms

## The Five Freedoms

Animals have the freedom to experience all of the following:

- Proper and sufficient food and water.
- Adequate shelter.
- The opportunity to display normal patterns of behaviour.
- Appropriate physical handling.
- Protection from, and rapid diagnosis of, injury and disease.

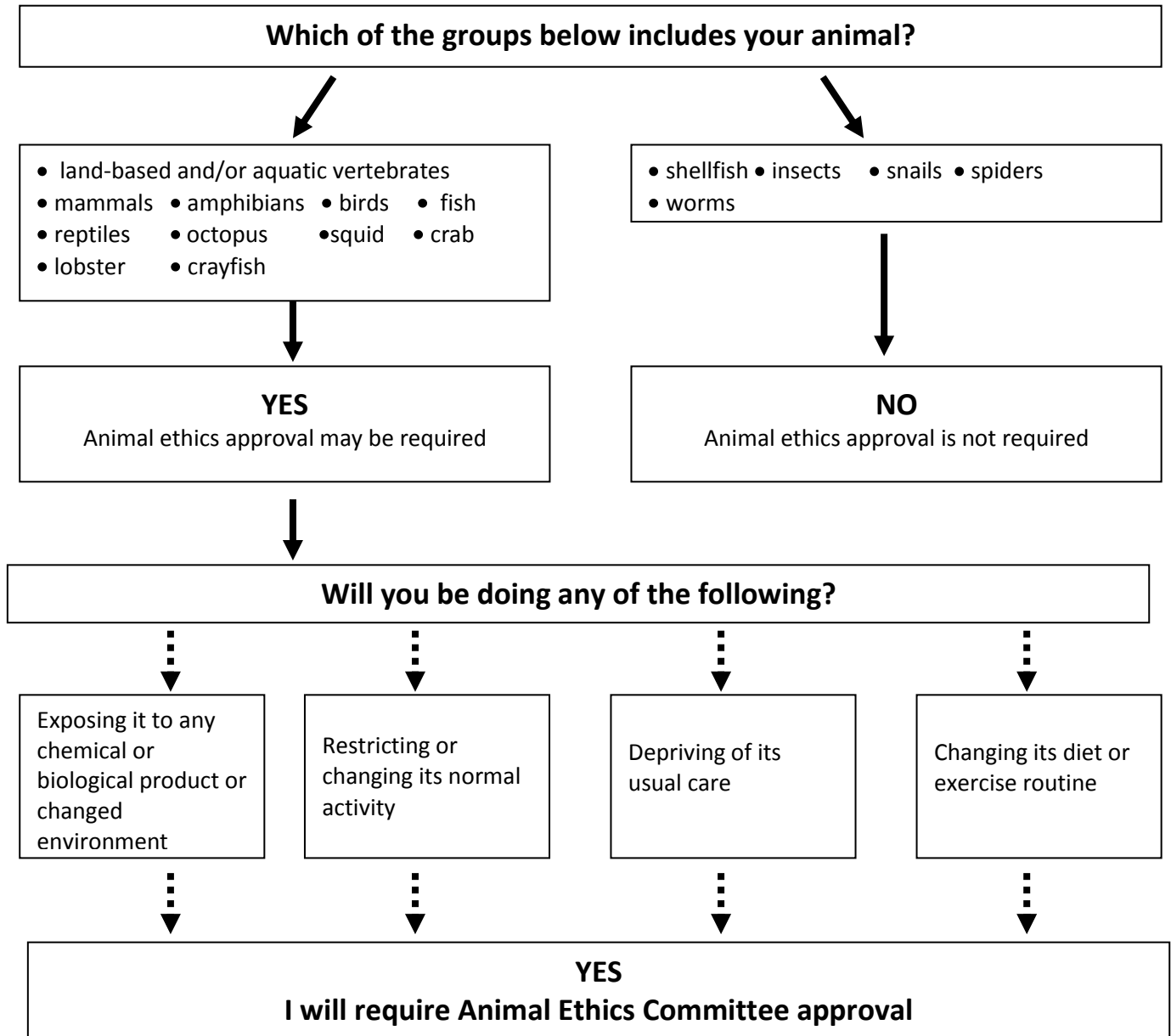


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# Do I need Animal Ethics Committee approval for my investigation?

Any investigation involving animals (vertebrate or invertebrate) that may be a NZ endangered species requires animal ethics approval.

Follow the chart below and **mark your pathway in red pen.**



More information is available at: <http://www.nzase.org.nz/ethics/guidelines.html>

Link to [Animal Ethics application form](#).

Complete the form and email it with a full copy of your plan to your teacher.

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# **Human Ethics Approval**

The following information is from the Royal Society of NZ and applies to any Science Fair / CREST project involving humans.

You will need to **obtain Human Ethics approval** for your project if your project involves any of the following situations:

- tasting, touching or smelling different foods or other substances
- taking any medicines, drugs or other substances?
- applying any substance to their bodies e.g. perfumes
- undergoing any physical or medical tests e.g. testing heart rate before and after exercise
- giving you any information of a personal, private or confidential nature e.g. questionnaires on food preferences or diet
- giving information that could identify them

## **How important is research design?**

People should only be asked to contribute to research that will give meaningful results. Design the research carefully and think about how you are going to use or analyse the results before you ask people to contribute to your work by being research participants.

If your project involves asking questions, you could try them first on your friends or relatives to determine whether they appear reasonable and acceptable, particularly from a stranger if that is how it will be posed.

## **What information do I need to give my research participants?**

When you ask people to participate in your research, you need to tell them in a language they can easily understand:

- the purpose of your research
- what will be required of them
- what risks or benefits there will be to them if they agree to work with you
- that they can withdraw from your research at any time
- if you are collecting information about people they should know beforehand whether or not the information can be linked to a particular person, what you will do with that information, who else will see it, and how you will dispose of your records when the project is over.

It is best to give this information to people in a written form and to give them a chance to think about it and to ask any questions, before they make any decisions.

## **What level of risk to research participants is reasonable?**

Any research that involves bodily fluids or the ingesting of material (e.g. such as taking any kind of medication, ingesting substances, testing body tissue, saliva, skin scrapes, use of pain or deprivation of basic food or drink) should only be done following full ethics committee approval by

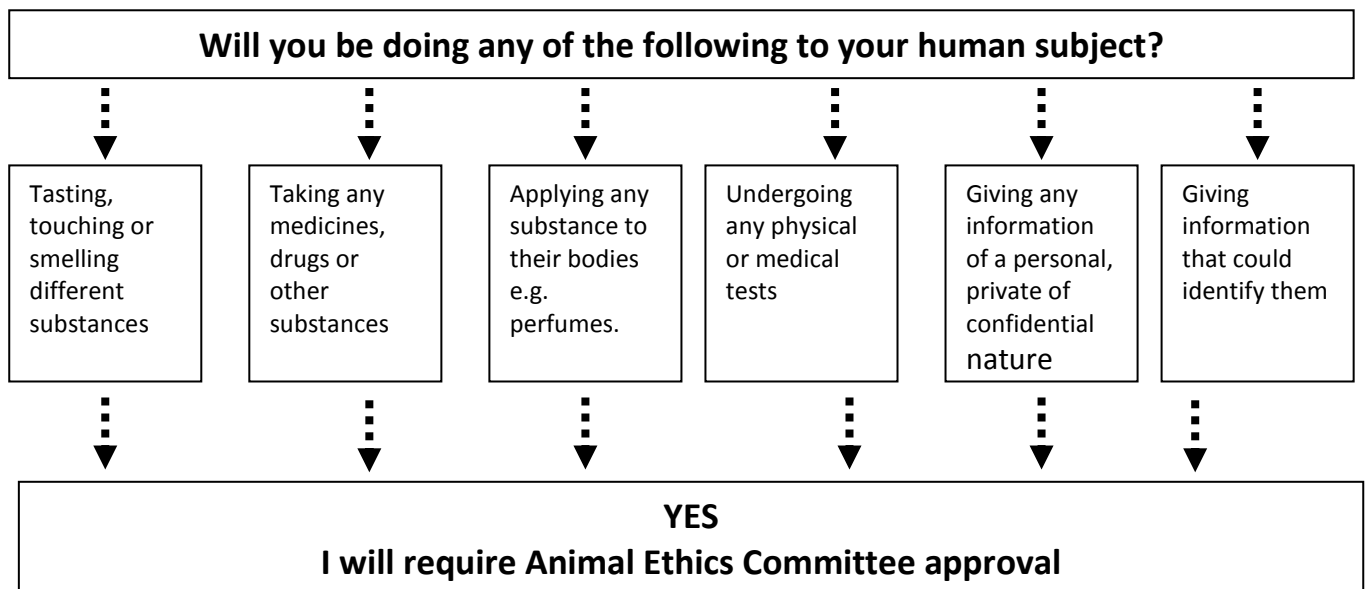
an accredited committee. It is very unlikely that you will be doing such projects while still at school.

Any project done without full ethics committee approval should only involve minimal risk i.e. any adverse effect should be very small, and the probability of that effect occurring should be low. For instance, if one is asking people for information, it should only be the sort of information it would be safe, easily volunteered and appropriate to ask in an ordinary conversation, or if you are asking people to exert themselves, physically it should only be to a level that that person might do in everyday life.

## Who needs to give permission (or consent) for someone to participate in research?

A parent or guardian needs to give their permission for **anybody under 16**, as well as the young person agreeing. The parent or guardian needs to have all the information that you would give a research participant.

You should keep records of who has given consent and how whenever the research involves more than observation of individuals in their normal activities.



Exemplars: [Participation Information Letter](#)

[Participation Information Form](#)

[Parental Consent Letter](#)

[Parental Consent Form](#)

[School Consent Letter](#)

[School Consent Form](#)

[Human Ethics Approval Form.](#)

Complete the form and email it with a full copy of your plan to your teacher.

More information can be found at

[http://www.royalsociety.org.nz/site/education/science\\_fairs/humanethicscode.aspx](http://www.royalsociety.org.nz/site/education/science_fairs/humanethicscode.aspx)

[Return to Student Guidelines](#)

## TIME LINE

[Return to Student Guidelines](#)

**TERM 1 2009**

## FEBRUARY

Week No	M O N	T U E	W E D	T H U	F R I	S A T	S U N
1					20 Getting Started Liggins	21	22
2	23	24	25	26	27	28	1

## MARCH

3	2	3	4	5	6 Milestone 1— Meet LENS teacher - Tamaki	7	8
4	9	10 Milestone 1— Meet LENS teacher	11	12	13	14	15
5	16	17	18	19	20	21	22
6	23	24	25	26	27	28	29
7	30 LENS teacher visit Tamaki	31 LENS teacher visit	1	2 LENS teacher visit	3	4	5

[illegible]



## Data Analysis and Reporting

You have 6 weeks to analyse your data and write your report. This is plenty of time, but you need to be well organised and take responsibility for your work.

***Remember this is your investigation, your data and your report.  
You get to do the work and reap the rewards!***

1. [Sections in the report](#) – what do you need in your report?

2. [Order of your work – what to do when?](#)

3. [Help and guidance:](#)

3.1 [Report formatting](#)

3.2 [References](#) – in your report and reference list

3.3 [Present your data.....](#)

3.3.1 [Tables](#)

3.3.2 [Graphs](#)

3.3.3 [Using simple excel formulae](#)

3.3.4 [Analysing data using statistical tools](#)

3.4 [Writing your conclusion, discussion and evaluation](#)

3.5 [Does your original method write up need editing?](#)

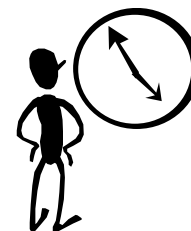


3.6 [Writing your introduction](#)

3.7 [Writing your abstract](#)

3.8 [Writing your acknowledgements](#)

3.9 [PROOF READING!](#)



***All reports are due in by Wednesday 10<sup>th</sup> August***

# 1. Sections in your report – what do you need?

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SECTION	CONTENT
<a href="#">Title Page</a>	An accurate, concise description of the project. <u>Please use the title page template on page 1 of the report document.</u>
<a href="#">Contents Page</a>	A list of sections in your report
Abstract	A short summary (10 – 15 lines) outlining the <b>purpose</b> of the project and the <b>key findings</b> .
Introduction	An outline of the background information and observations, which led to the formation of your hypothesis. This section should explain the <b>biological concepts</b> relating to the <b>hypothesis</b> and <b>describe</b> the <b>events</b> that would be <b>expected</b> in the investigation as a result of your knowledge of biological concepts. You should <b>reference literature</b> relating to the topic of investigation in this section to establish the extent to which you have researched the topic prior to starting your investigation. This should be written in third person.
Aim	A formal statement of the aim of the investigation
Hypothesis	A formal statement of the expected outcome of the investigation. A null hypothesis stating that there is no difference or no effect should also be included ,as it will be used in the statistical analysis Note – hypotheses are written in the following format: <i>“That.....” e.g. That salinity of water will increase the rate of .....</i>
Method	An accurate description of the materials and experimental procedure used in the investigation, written in <b>third person</b> . <b>The method should be written in such a way that an independent person could repeat the experiment without consultation to the author.</b>
Results	A full description of the results including statistical tests. Results should be presented as a series of <b>tables</b> and <b>graphs</b> accompanied by <b>explanations</b> . Your results section should be a summary of your findings. This will often require you to combine several raw data tables into one. Result tables and graphs should allow the reader to look at one graph or table and make comparisons.
Conclusion and Discussion	This is a statement of <b>conclusion</b> relating the findings of the investigation back to the aim and hypothesis, followed by an <b>in-depth discussion</b> of the biological significance of the results. If your results do not support known biological facts or theories, you should discuss this discrepancy.
Evaluation	An outline of the <b>assumptions</b> that were made in the investigation; problems encountered and a critical evaluation of the effect of these in the investigation. This includes analysis of <ul style="list-style-type: none"> <li>• <b>limitations</b> of the investigation</li> <li>• potential sources of error</li> <li>• the level of <b>validity</b> of the method</li> <li>• <b>reliability</b> of the data and statistical analysis</li> <li>• The potential for further investigation that may be appropriate</li> </ul>
References	All sources cited (referred to) in the text of your report should be listed in full using the format outlined in this handout. Please make sure that you follow these instructions.
Acknowledgements	Complete the <a href="#">acknowledgements form</a> stating clearly any assistance that you received during the investigation from your teacher, mentor, peers or other individuals.
Appendices	Appendices can be used to show information that is relevant to the investigation but not required within the body of the report. This may include items such as your statistical workings; raw data tables; additional information relating to parts of the method – such as information on the development of a piece of apparatus that was used in the investigation.
Log Book	Your log book <b>MUST</b> accompany your report.

## 2. Order of your work – what to do when?

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*Now that you have collected all your data, you are ready to analyse the data and write up your report. BUT before you can write your report, you must spend time analysing your data and finding trends and patterns that will help you draw conclusions.*

*Please remember to keep your log book current – make an entry in your log every time you do work on your project.*

Steps in the process from here.....

1	Organise the files on your computer and the format for writing your report	
2	Keeping your reference list active as you write.....	
3	Put your data into tables using excel	
4	Graph your data using excel	
5	Identification of patterns and trends in your data	
6	Statistical analysis of your data	
7	Write your conclusion – linking directly back to your aim and hypothesis	
8	Write your discussion	
9	Write your evaluation	
10	Check your method write up and edit as required.	
11	Check your introduction write up and edit as required	
12	Check that your reference list is complete and accurate	
13	Write your abstract	
14	Write your acknowledgements	
15	Write your title page	
16	Proof read your report	
17	Get someone else to proof read and criticise your report! Take their advice and edit as required.	
18	Hand in your report and make a time for your assessment conversation.	
19	Once you get your report back, you will come into the classroom to design and make your poster presentation for Science Fair.	
20	Prepare and practise for your presentation at the Auckland Science Fair on October 19 <sup>th</sup> .	
21	Prepare and practise for your presentation to School Principals and Scientists at the Liggins Institute on October 22 <sup>nd</sup> .	



### 3 Help and Guidance

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### 3.1 Report formatting

**Follow these instructions from the beginning of your work so that you do not have to reformat at the end of your report writing process. The second part of this document contains a template for your report – please use this template.**

### 3.1.1 General formatting

Font:	Use a standard font such as Arial or Times New Roman
Font Size:	11 point for the text. Headings can be a larger font size – e.g. 14 -16pt.
Spacing:	Double-spaced lines
Graphs:	Preferably created using Excel but may be hand drawn.
Diagrams:	May be hand drawn, scanned or computer generated. If copied, references must be cited.
Photographs:	Should be used to illustrate and provide evidence throughout.

### 3.1.2 Sections, Paragraphs and Headings

Each section should have a title – the [sections are listed for you on page 2](#)

Within each section, subsections should be titled.

Example: In this example you can see that the investigation method had several parts to it.

## 5. Method

### 5.1 Planting and care

- a) ZZZZZZZZZZZZZZZZZZ.....
- b) zzzzzzzzzzzzzzzzzz.....
- c) zzzzzzzzzzzzzzzzzz.....

## 5.2 Measuring Chlorophyll Content

- a) Aaaaaaaaaaaaaaaaaa.....
- b) Bbbbbbbbbbbbbbbbbb.....

### 5.3 Measuring Dry Mass

- a) Cccccccccccccccc.....
- b) Dddddddddddddddd.....

Figures include photos, diagrams and graphs and are labelled according to the section that they are in.

Tables are labelled according to the section that they are in.

### **Examples:**

The table and photo in the example below are both in section 5 of the report

## 5.Method

### Measuring Rate of Photosynthesis

Xxxxxxxxxxxxx.....

Yyyyyyyyyyyyy....

Zzzzzzzzz.....

This is the 7<sup>th</sup> Figure in section 5 of the report – therefore it is labelled Fig. 5.7



The syringes were placed under 6000 Lux to test the rate of photosynthesis of spinach grown under different light intensities.

**Fig. 5.7 Syringe under 6000 Lux**

Title of the table		

Table 5.1 – XXXX *this would be labelled this way as the 1<sup>st</sup> table in section 5 of the report.*

## 3.2 References

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Citing (or listing) of references is the way in which scientists show that they have searched the published literature to find out what is already known about the topic of investigation and recognise the work of others. There are two aspects to referencing in your report:

- a. The reference list at the back of your report showing all references that you have used.
- b. Citations or quotes within the text of your report which show where you have obtained specific information that you are using in the report.

### 3.2.1 Creating the Reference List

#### For Books:

This is written in the form: author, date of publication, title, and publication information.

- **Author(s)** Write the family name then initials for all authors. Use commas to separate authors. Finish with a full stop, e.g. Selinger, B.
- **Date of publication.** Give the year the work was published in brackets, e.g. (1989).
- **Title.** This is in *italics* with additional information in brackets to enable identification, e.g. *Chemistry in the Marketplace* (4<sup>th</sup> ed.).
- **Publication information.** Give the name of the city, then a colon followed by the name of the publisher written as briefly as possible, e.g. leave out terms like *publishers*, *Co.* e.g. Sydney: Heinemann.

This goes together as follows:

Selinger, B. (1989). *Chemistry in the Marketplace* (4<sup>th</sup> ed.) Sydney: Heinemann

#### For Periodicals:

This is written in the form: author, date of publication, article title, journal title, and publication information.

- **Author(s) and date of publication.** This is the same as for books, e.g. Becker, L.J. & Seligman, C. (1981).
- **Article title.** This is in normal type, e.g. Welcome to the Energy Crisis.
- **Journal title and publication information.** Give the journal title in full in *italics*. Next give the volume number but do not use "Vol." before the number. Finally give the page numbers. Use "pp" before the page numbers in newspapers and magazines but not in references to journal articles, e.g. *Journal of Social Issues*, 37, 1-7.

This goes together as follows:

Becker, L.J. & Seligman, C. (1981). Welcome to the Energy Crisis. *Journal of Social Issues*. 37, 1-7

#### For the Internet:

Where you use information from the Internet e.g. text, photographs, maps or anything else you should provide three pieces of information. These are:

- the web address
- what organisation or person is in charge of the web site. This gives some idea of how authoritative the site is
- the date you accessed the web page

This is written in the form:

[www.usgs.com/catastrophism/asaro](http://www.usgs.com/catastrophism/asaro) (United States Geological Society, 12.02.02)

### 3.2.2 Quotes and citations within the body of your report.

These can either be written as footnotes or can be listed in the text as the author name and year. You must include the authors name, date of publication, internet site address. If appropriate you may also include the page number or chapter from a book or journal.

e.g. Bay and Scott, 2005, p.51

In the reference list you will have a full citation of this reference –

e.g. Bay, J. & Scott C. (2005) *AME Level 1 Biology*, ESA Publications

The examples below are from the investigation report written by Bonnie Leung (2006). Bonnie prepared this report for NCEA Biology 3.1 and presented it at the Auckland Science Fair and Realise the Dream. She received a number of awards from this work including an undergraduate fees scholarship from the University of Auckland. Note that if you have used a large number of internet sources, it is recommended that you use the footnote method.

Example 1 – citations listed in footnotes. This is a tidy way of making citations, particularly if you are citing from web sources.

.....the granum is a stack of thylakoids which contain chlorophyll within the chloroplasts<sup>1</sup>. This structure helps increases the surface area so that the absorption of light is more effective. Light is used to split the hydrogen from water molecules while ADP is converted into ATP in the electron transport chain. Carbon fixation then begins in the stroma of the chloroplasts. This process involves the hydrogen atoms and ATP from the light reactions to combine with carbon dioxide so that glyceraldehydes-3-phosphate is formed. This compound eventually is converted into carbohydrate which is then used for other chemical processes in the plant.<sup>2</sup>

<sup>1</sup> "Photosynthesis" <http://micro.magnet.fsu.edu/primer/java/photosynthesis/> (20/6/06)

<sup>2</sup> Relph, David. (1986) *Life Science*. New Zealand: Heinemann Education

Example 2 – citations listed within the body of the text. These are highlighted so that you can see them. You would not highlight in your text.

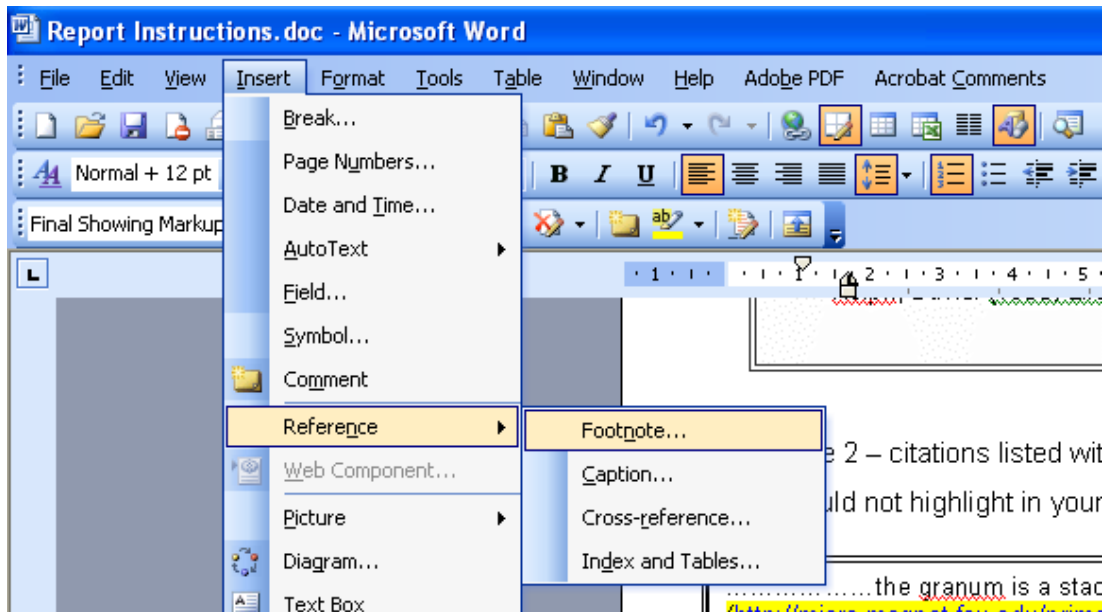
.....the granum is a stack of thylakoids which contain chlorophyll within the chloroplasts (<http://micro.magnet.fsu.edu/primer/java/photosynthesis/> (20/6/06)). This structure helps increases the surface area so that the absorption of light is more effective. Light is used to split the hydrogen from water molecules while ADP is converted into ATP in the electron transport chain. Carbon fixation then begins in the stroma of the chloroplasts. This process involves the hydrogen atoms and ATP from the light reactions to combine with carbon dioxide so that glyceraldehydes-3-phosphate is formed. This compound eventually is converted into carbohydrate which is then used for other chemical processes in the plant (Relph, 1986)

### 3.2.3 How to create a footnote:

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#### **For Word 97-2003**

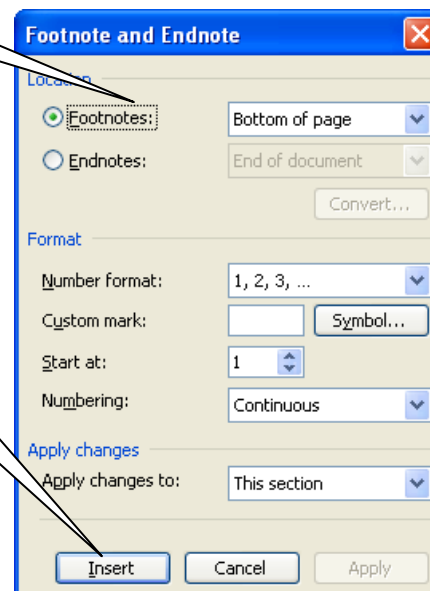
- a) Write your text as normal<sup>1</sup>.
- b) When you get to the end of the sentence where you want to put the citation, select insert,



Select Footnotes and  
Bottom of page

Click on insert

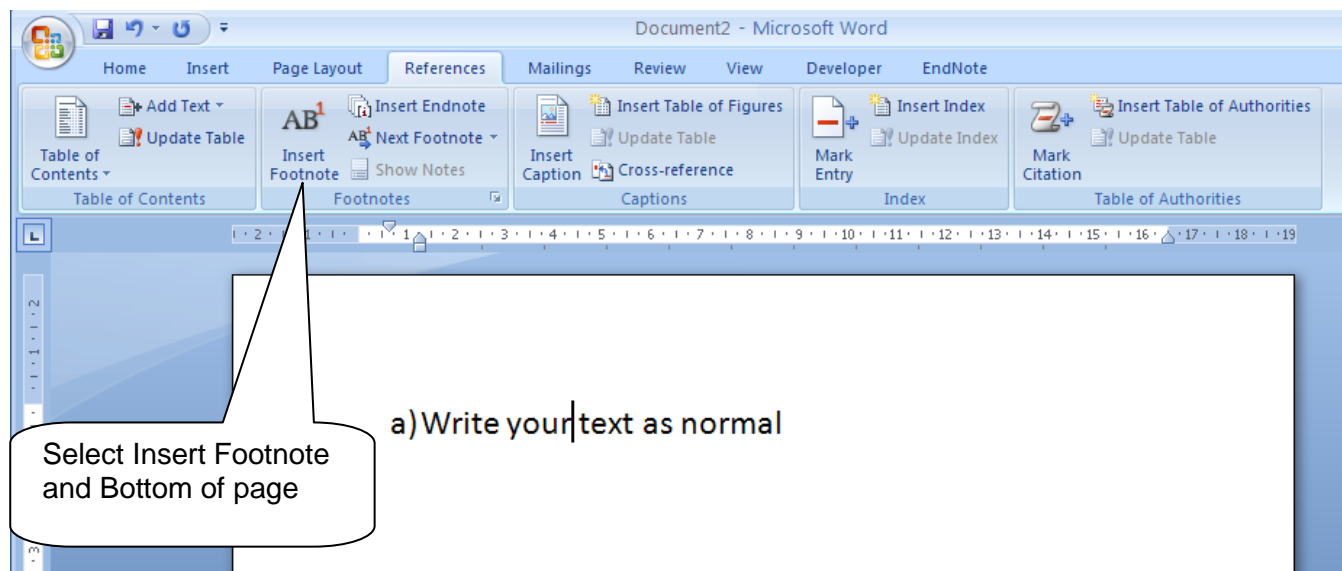
Type your reference in at the  
bottom of the page.



<sup>1</sup> Type your reference in here according to the instructions on page 7

## For Word 2007

- a) Write your text as normal<sup>2</sup>.
- b) When you get to the end of the sentence where you want to put the citation, select Reference, Insert footnote.....



Type your reference in at the bottom of the page.

---

<sup>2</sup> Type your reference in here according to the instructions on page 7

### 3.3 Presenting your data

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- Data should be presented in both tables and graphs.
- These should show trends in the data.
- They will often be summarising the data.
- All raw data must be shown in an appendix as well as in your log book.

#### **What does a high quality report need?**

- Sufficient data appropriately and *systematically recorded and processed*
  - *Systematic* means it is well organised and logically presented
  - *Recording* your data is seen in your log book (raw data tables), and in your report (summary data tables).
  - *Processing* your data refers to what you do with your data.
    - Averaging multiple samples
    - Statistical analysis
    - Graphs and charts
- Data presented so that it can be interpreted without reference to the method. This means that when you look at the table or graph you can easily see what the experiment was about.

### 3.3.1 Tables

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#### Tables must have:

- An accurate title.
- Column and Row headings
- Correct units in the appropriate headings
- Averages where appropriate

The columns have a heading that tell you **what was measured** and the **units** – in this case moles per litre ( $\text{Mol L}^{-1}$ )

This column heading is for the **dependent variable** – in this case the rate of reproduction of the daphnia.

Table 1.1  
Effect of salinity on reproductive rate of daphnia.

Salinity [NaCl] $\text{mol L}^{-1}$	Reproductive Rate (average number of new daphnia per day)			
	Trial 1	Trial 2	Trial 3	Av.
0.1				
0.2				
0.4				
0.6				

This column is recording the **independent** variable (the thing that you changed in the experiment).

Each test was **repeated** 3 times. The raw data for **each test** and the **average** of the 3 tests is shown.

#### Mistakes that we often see in tables:

- Do not put units in each cell – units must be in the column heading
- This error will also stop you from using the formula functions in excel.



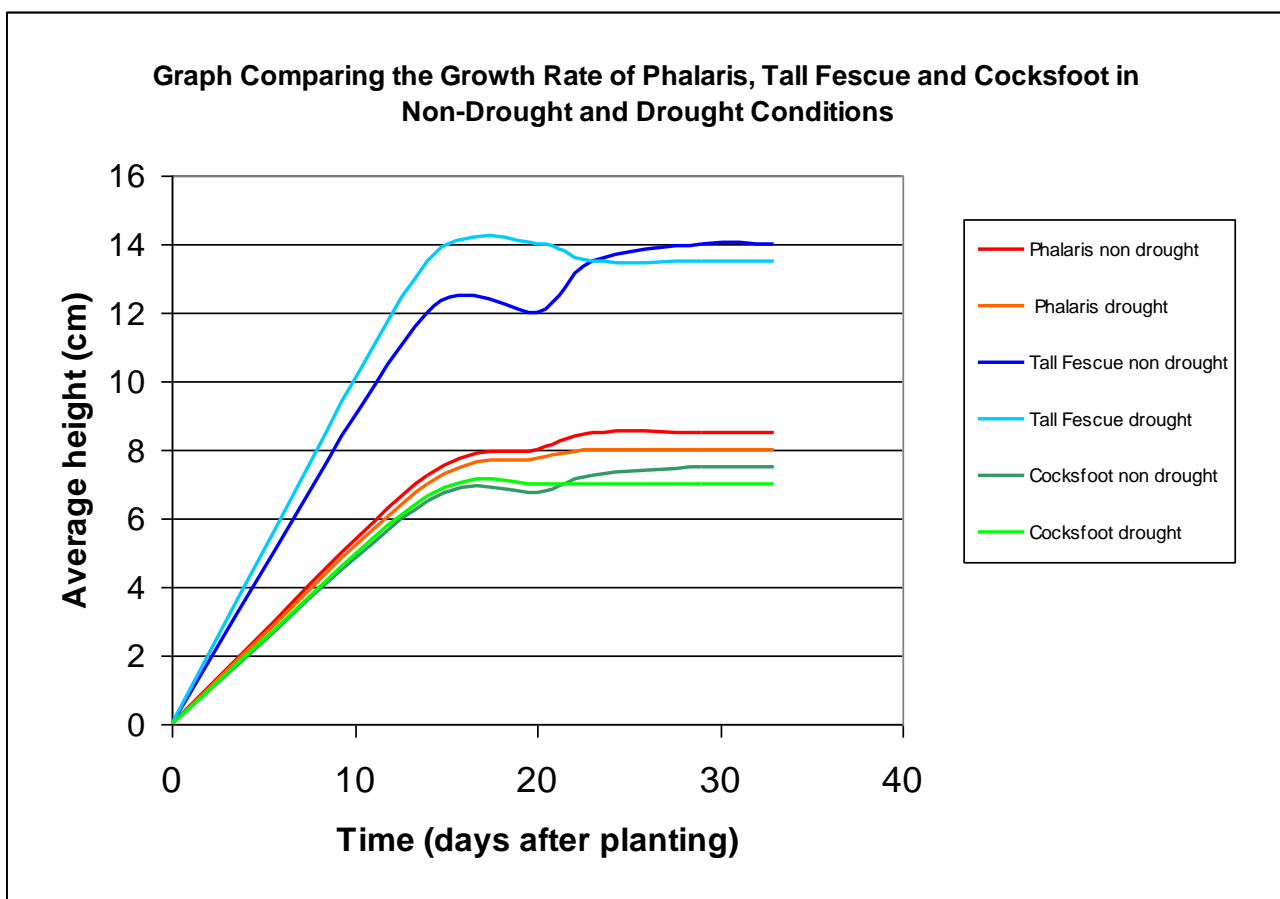
### 3.3.2 Graphs

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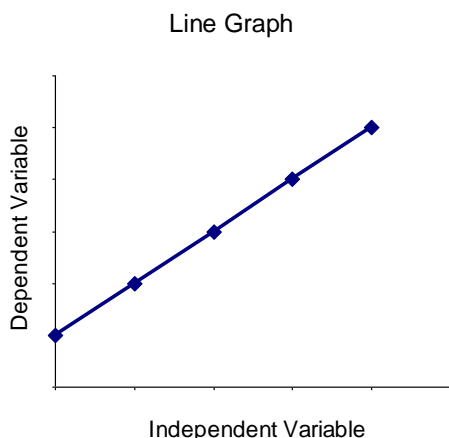
Graphs are a visual way of presenting your data – they allow you to see trends and patterns in the data. There are different types of graphs which are used for different types of data. We will look at that soon, but here are some general rules for graphs.

Graphs should have:

- An accurate title that fully describes the data represented.
- Axes labels – again full descriptions
- Correct units on each axis
- A key where appropriate
- Must show all appropriate comparisons on ONE set of axes.



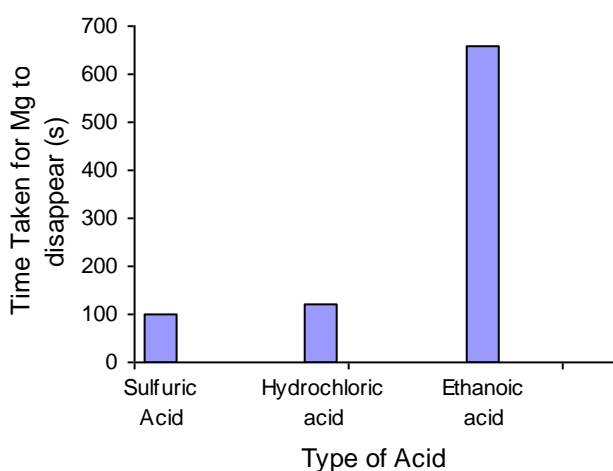
## Line Graphs



- Line Graphs are used to represent continuous data where you have one variable affecting another.
- The independent variable is on the X-axis
- The Dependent variable is on the Y-axis.
- In excel these are drawn using the x-y scatter graph tool NOT the line graph tool!
- You can use this tool to have multiple lines on the one axes – which allows comparisons to be made.

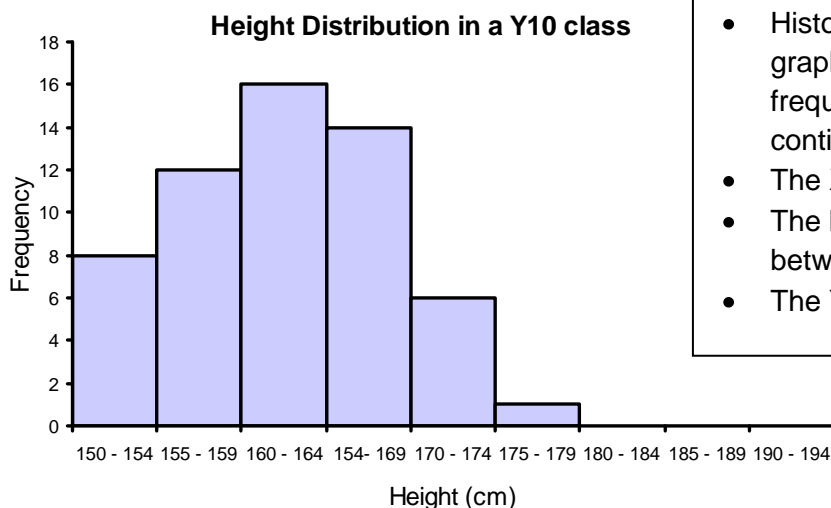
## Bar Graphs

**Effect of type of acid on the time taken for Mg Ribbon to disappear**



- Bar Graphs are used to represent discrete data
- Discrete data is often in categories e.g. the type of acid used in a reaction; type of diet given to animals
- The independent variable is on the X-axis
- The dependent variable is on the Y-axis

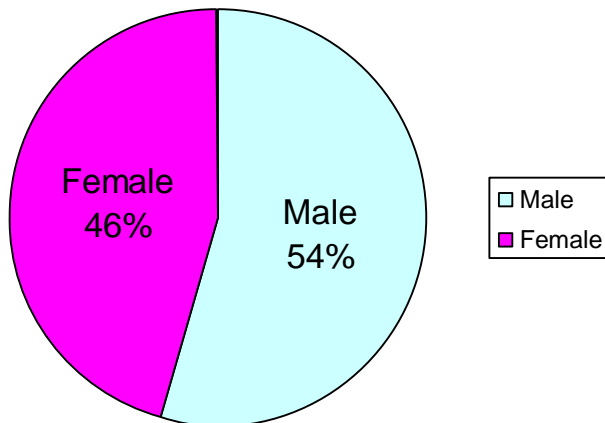
## Histograms



- Histograms are a special type of bar graph where you are recording the frequency of an event within a continuous time line.
- The X-axis is a continuous number line
- The bars must touch as there is no gap between the groups of data
- The Y-axis is a frequency count.

## Pie Chart

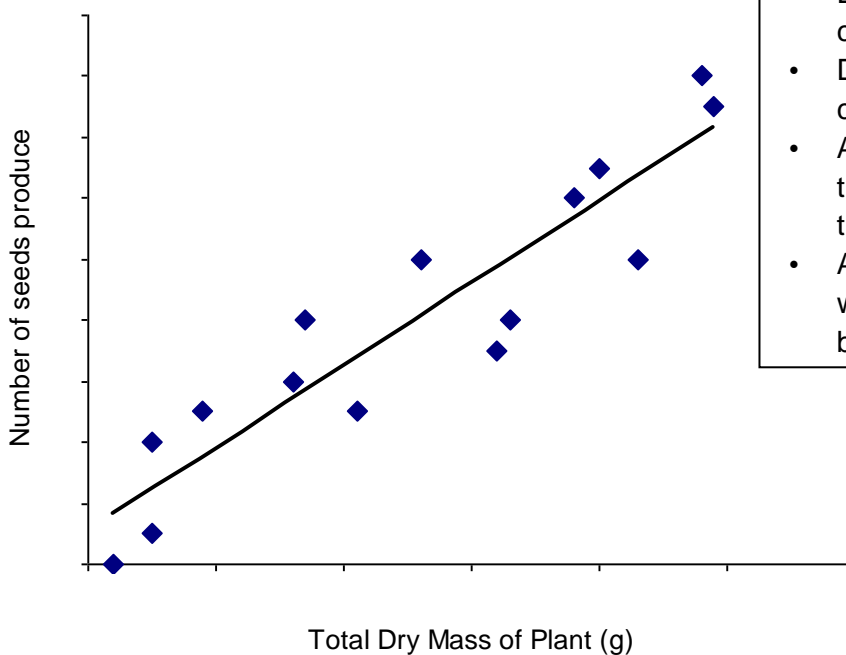
Sex of Offspring from 1st Generation - *Drosophila*



- Data is discrete
- Useful to show proportions
- Very good for visual impact
- Not useful if you have multiple categories
- You can show values in the graph

## Scatter Graph

Relationship between total dry mass of plant and number of seeds produced in *Brassica rapa*



- Data for both variables is continuous
- Data is plotted but is not connected
- A line of best fit can be drawn through the data to indicate a trend
- A very good way of finding out whether there is a relationship between two variables

### 3.3.2.2 Using Excel to make graphs

#### For Word 97-2003

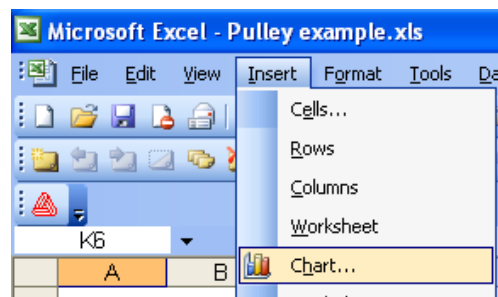
1. Your data must be in an excel table.

	A	B	C	D	E	F	G	H	I	J	K
1	Effect of drought conditions on growth rate of Tall Fescue grass										
2		Tall Fescue non drought						Tall Fescue drought			
3	Time (days)	Height (cm)						Height (cm)			
4		Exp.1	Exp.2	Exp.3	Exp.4	Average	Exp.1	Exp.2	Exp.3	Exp.4	Average
5	0	0	0	0	0	0	0	0	0	0	0
6	14	12	12	12	12	12	14	13	14	13	13.5
7	20	12	12	12	12	12	14		14		14
8	23	13.5	13.5	13.5	13.5	13.5	14	13	14	13	13.5
9	29	14	14	14	14	14	14	13	14	13	13.5
10	33	14	14	14	14	14	14	13	14	13	13.5

2. Select the columns that you want to plot by holding down the control key while you select the columns. The columns you have selected will show us as blue.

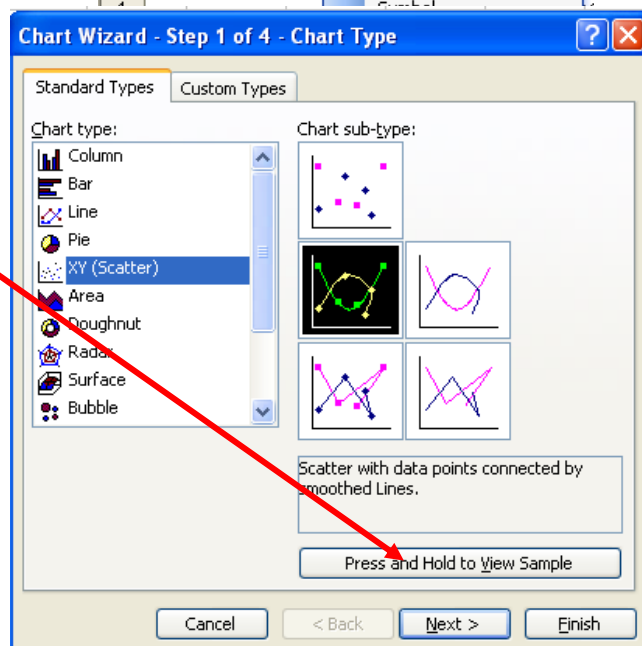
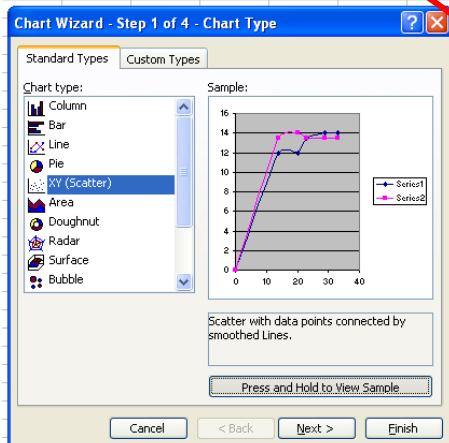
K5											
	A	B	C	D	E	F	G	H	I	J	K
1	Effect of drought conditions on growth rate of Tall Fescue grass										
2		Tall Fescue non drought						Tall Fescue drought			
3	Time (days)	Height (cm)						Height (cm)			
4		Exp.1	Exp.2	Exp.3	Exp.4	Average	Exp.1	Exp.2	Exp.3	Exp.4	Average
5	0	0	0	0	0	0	0	0	0	0	0
6	14	12	12	12	12	12	14	13	14	13	13.5
7	20	12	12	12	12	12	14		14		14
8	23	13.5	13.5	13.5	13.5	13.5	14	13	14	13	13.5
9	29	14	14	14	14	14	14	13	14	13	13.5
10	33	14	14	14	14	14	14	13	14	13	13.5
11											
12											

3. Use either the chart wizard short cut or use insert chart from the tool bar.

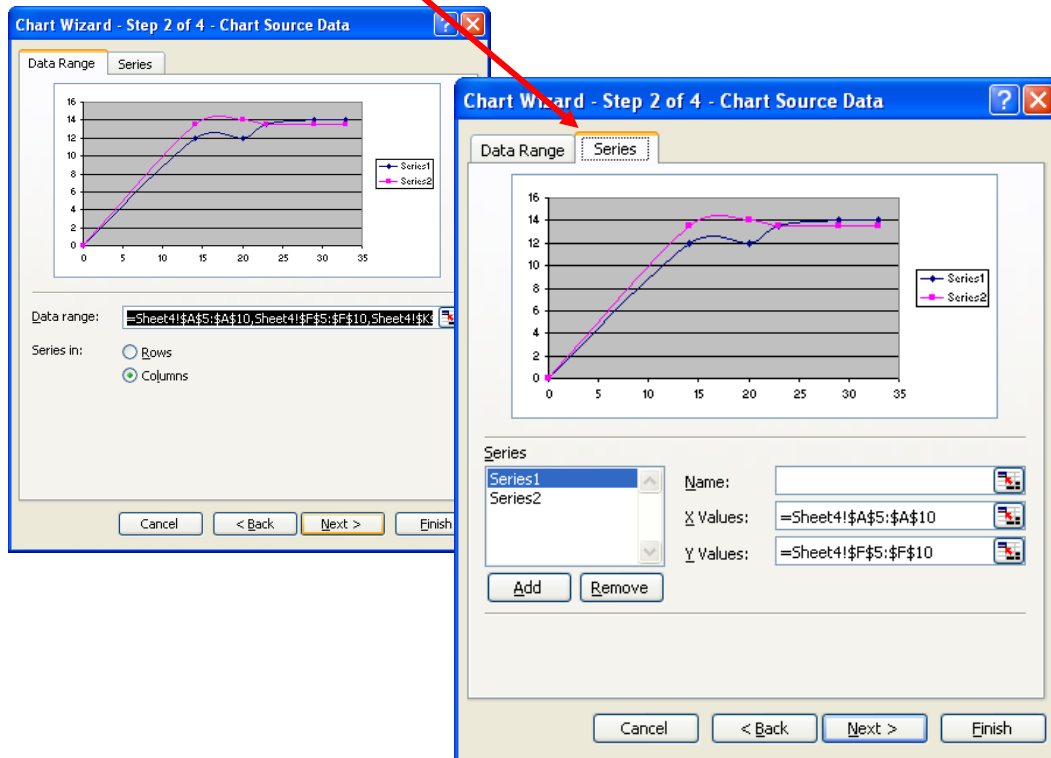


4. Select the type of chart that you want.

Press and hold to view a sample of what your chart will look like.



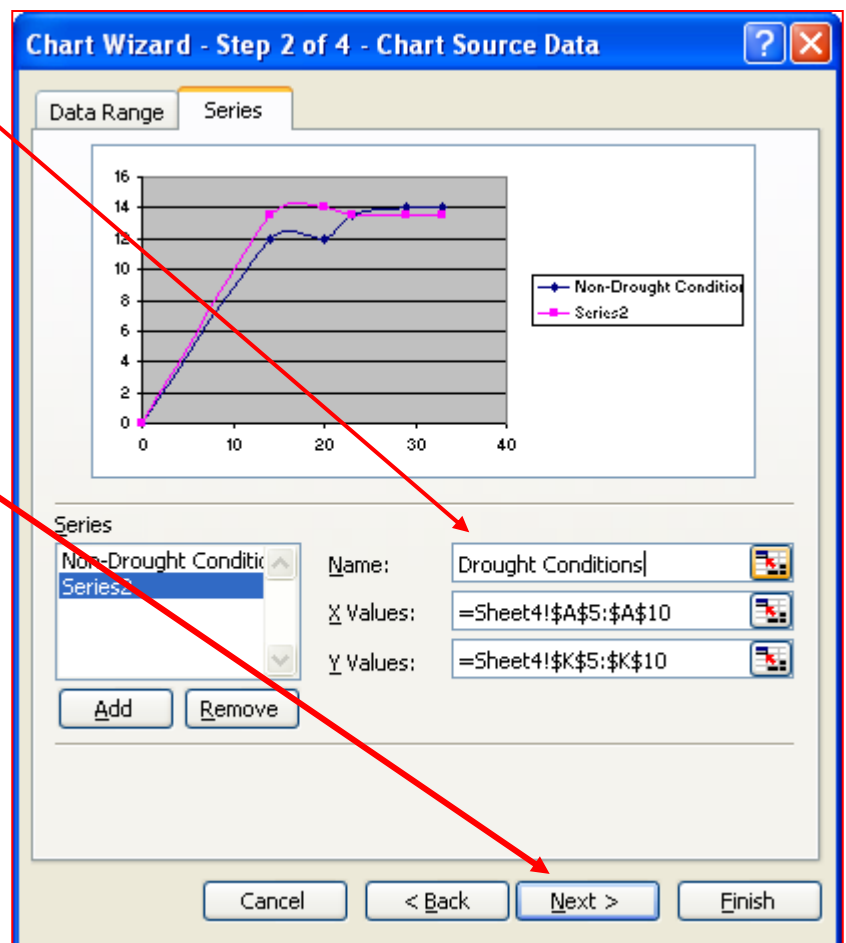
5. Click next and then select Series



6. Type the name of the series in.

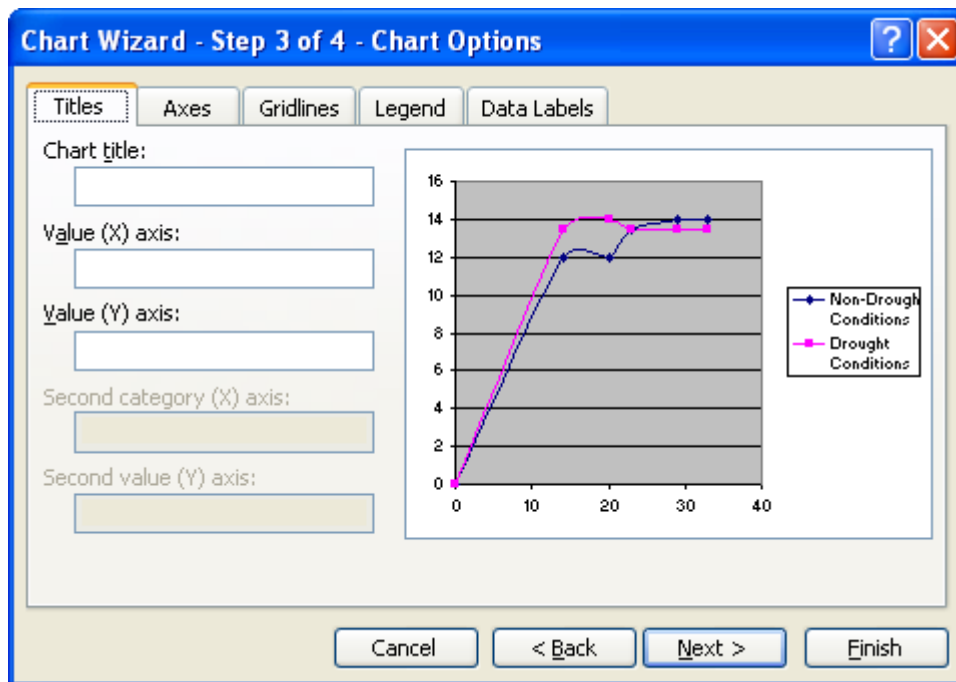
At this point you may also select to add more series – this would mean you were adding more lines to the graph – i.e. additional data.

Click Next

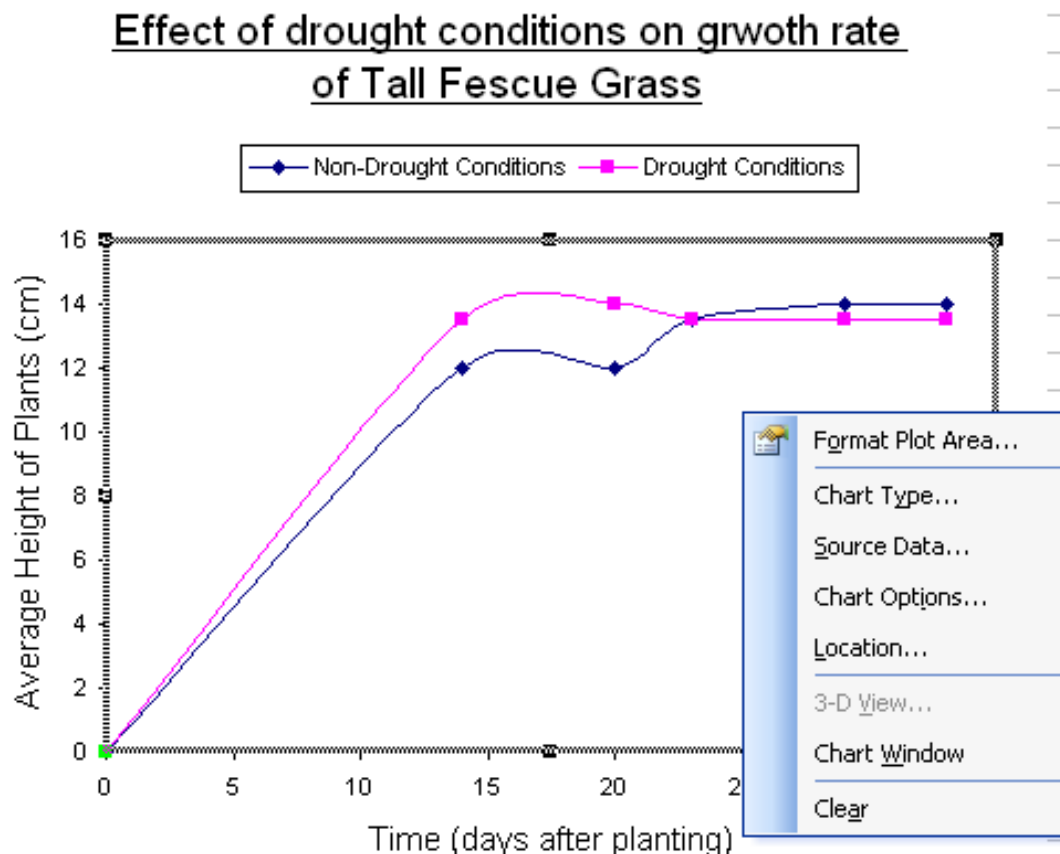


7. Now you are ready to add titles, legends etc to your graph

Click on each heading tab and work your way through until you have added a title, labelled axes, chosen grid lines, backgrounds etc.



8. When you have finished, click on finished. You can now format the style of the text etc by right clicking on any part of the graph that you want to change. Once you are finished, copy your graph into your word document.



## For Word 2007

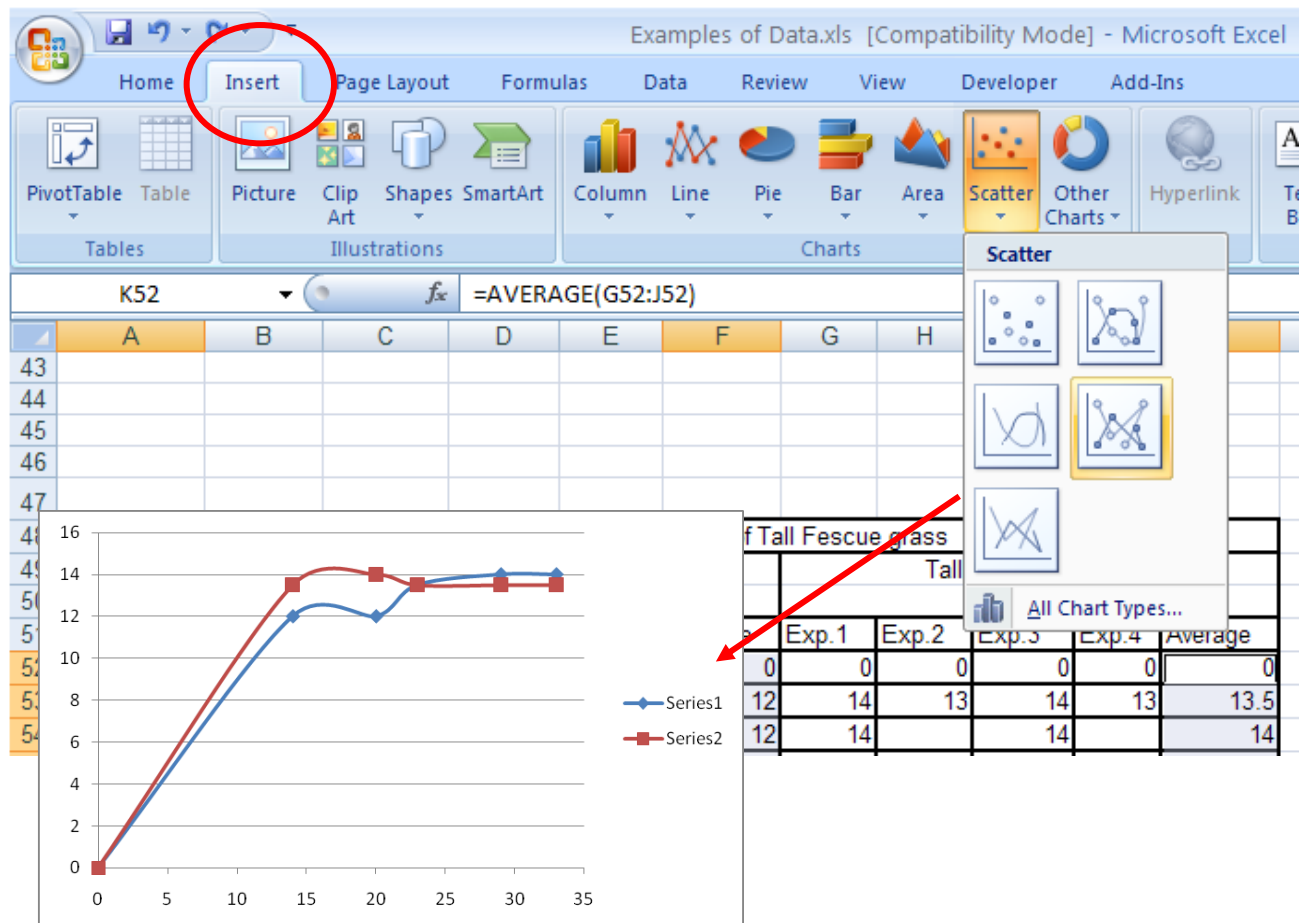
1. Your data must be in an excel table.

	A	B	C	D	E	F	G	H	I	J	K
1	Effect of drought conditions on growth rate of Tall Fescue grass										
2	Tall Fescue non drought					Tall Fescue drought					
3	Time (days)	Height (cm)					Height (cm)				
4		Exp.1	Exp.2	Exp.3	Exp.4	Average	Exp.1	Exp.2	Exp.3	Exp.4	Average
5	0	0	0	0	0	0	0	0	0	0	0
6	14	12	12	12	12	12	14	13	14	13	13.5
7	20	12	12	12	12	12	14		14		14
8	23	13.5	13.5	13.5	13.5	13.5	14	13	14	13	13.5
9	29	14	14	14	14	14	14	13	14	13	13.5
10	33	14	14	14	14	14	14	13	14	13	13.5

2. Select the columns that you want to plot by holding down the control key while you select the columns. The columns you have selected will show us as blue.

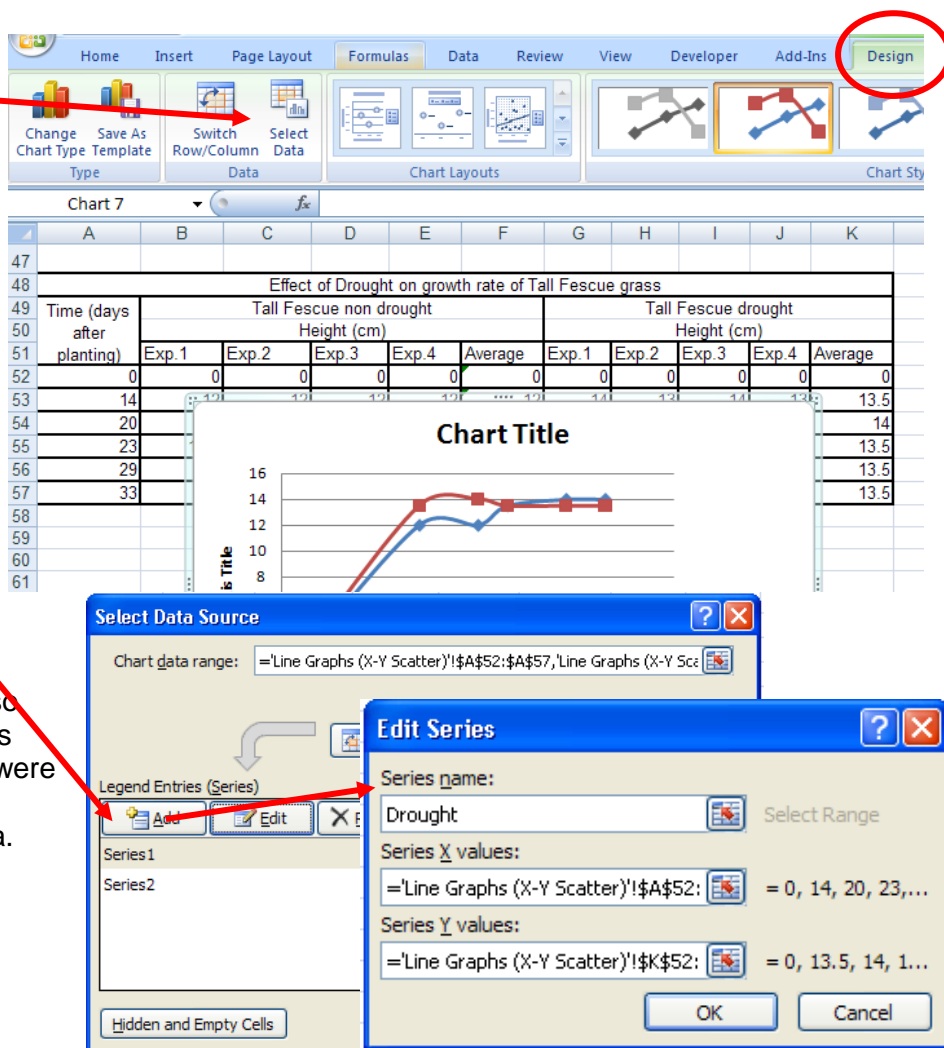
K5											
	A	B	C	D	E	F	G	H	I	J	K
1	Effect of drought conditions on growth rate of Tall Fescue grass										
2	Tall Fescue non drought					Tall Fescue drought					
3	Time (days)	Height (cm)					Height (cm)				
4		Exp.1	Exp.2	Exp.3	Exp.4	Average	Exp.1	Exp.2	Exp.3	Exp.4	Average
5	0	0	0	0	0	0	0	0	0	0	0
6	14	12	12	12	12	12	14	13	14	13	13.5
7	20	12	12	12	12	12	14		14		14
8	23	13.5	13.5	13.5	13.5	13.5	14	13	14	13	13.5
9	29	14	14	14	14	14	14	13	14	13	13.5
10	33	14	14	14	14	14	14	13	14	13	13.5

3. Use the Insert tool bar and select the type of chart that you want



- Use the **Design** tab and select the **Chart Layout**. Now you can label the axis and title by double clicking over them and typing in the appropriate labels for your graph. To format the labels go to the home tab and use the font and alignment boxes as you would normally.

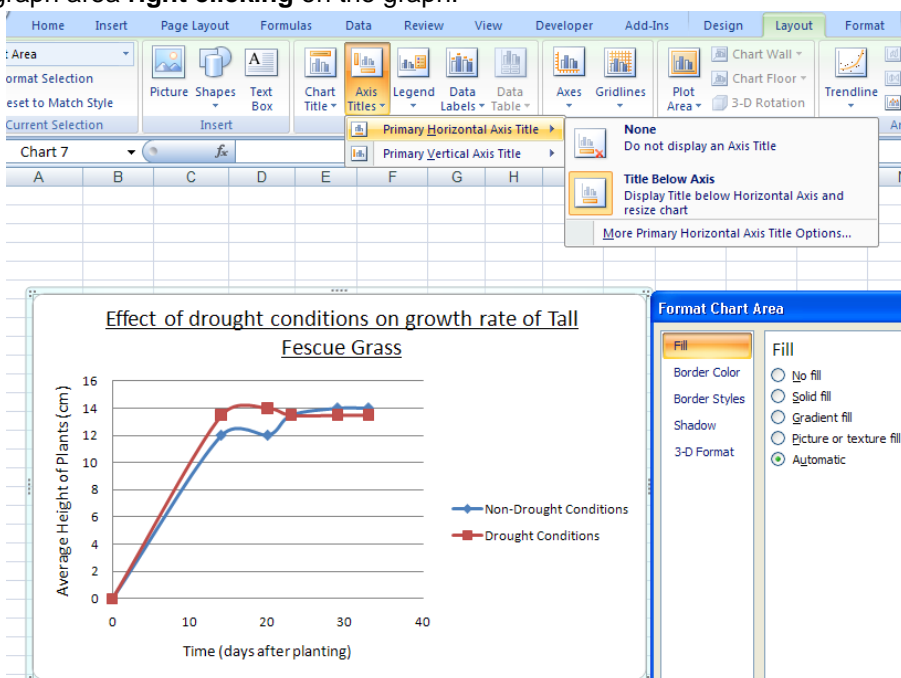
- To label the Series click on **Select data**.



Click on **Series 1**, then click on **Edit** and type in the label.

At this point you may also select to add more series – this would mean you were adding more lines to the graph i.e. additional data.

- To format your finished graph select the **Layout** tab and select the position of your labels, axes and gridlines. To format your graph area **right clicking** on the graph.



Once you are finished, copy your graph into your word document.



### 3.3.3 Using Excel Formula Functions

The formulae functions in excel can be used to do many things. Here are some of the more commonly used functions that will be useful to you:

- Sum – adds all numbers in a range
- Average – gives average of all numbers
- Max / Min – gives the largest or smallest number in your range
- Count – counts the number of pieces of data that you have in a range
- Count IF – counts the number of cells in a range that meet a given criteria – e.g. you may want to count how many times you got a certain value in your results.

Here is one example of how to use the function keys.

#### Finding the average of a series: For Word 97-2003

1. Click in the cell that you want to average to go into.

2. Either select insert function *fx*.....

3.... OR select the drop down menu from the sum tool on the shortcuts.

4. Select the function that you want – in this case average.

5. Select the cells that you want to average and click enter.

AVERAGE							=AVERAGE(B5:E5)	
	A	B	C	D	E	F	G	
1	Effect of drought conditions on growth rate of							
2	Time (days after planting)	Tall Fescue non drought						
Height (cm)								
3		Exp.1	Exp.2	Exp.3	Exp.4	Average	Exp.1	
4		0	0	0	=AVERAGE(B5:E5)			
5	14	12	12	12	AVERAGE(number1, [number2]			
6	20	12	12	12	12			
7	23	13.5	13.5	13.5	13.5			

6. If you want to repeat this formula in the cells below, take the bottom right corner of the cell and drag it down to the cells that you want the formula to apply to.

=AVERAGE(B5:E5)				
C	D	E	F	G
Effect of drought conditions on growth rate of Tall Fescue non drought				
Height (cm)				
Exp.2	Exp.3	Exp.4	Average	Exp.5
0	0	0	0	0
12	12	12	12	12
12	12	12	12	12
13.5	13.5	13.5	13.5	13.5
14	14	14	14	14
14	14	14	14	14



### Finding the average of a series: For Word 2007

1. Click in the cell that you want to average to go into.

2. Either select the drop down menu from the sum tool on the shortcuts.....

3. OR use the Formulas tab and select insert function *fx*

3. OR use the Formulas tab and select insert function *fx*

**Insert Function**

Search for a function: Average

Or select a category: Most Recently Used

Select a function:

- AVERAGE
- IF
- AND
- TRUE
- OR
- SUM
- HYPERLINK

**AVERAGE(number1,number2,...)**

Returns the average (arithmetic mean) of its arguments, which can be numbers or names, arrays, or references that contain numbers.

4. Select the function that you want – in this case average.

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5. Select the cells that you want to average and click enter.

Function Arguments

AVERAGE

Number1: B5:E5 = {0,0,0,0}

Number2: = number

6. If you want to repeat this formula in the cells below, take the bottom right corner of the cell and drag it down to the cells that you want the formula to apply to.

=AVERAGE(B5:E5)

Effect of drought conditions on growth rate of Tall Fescue non drought

Height (cm)

Exp. 2 Exp. 3 Exp. 4 Average Exp. 1

0 0 0 0 0

12 12 12 12 12

12 12 12 12 12

13.5 13.5 13.5 13.5 13.5

14 14 14 14 14

14 14 14 14 14



## HELP YOURSELF TO HELP!

Stuck - Hit the Help key – F1 to get help with any question you have.

Type in your question and select the help - follow the instructions and learn how to teach yourself to be an excel expert!

Microsoft Excel Help

Calculate the average of numbers in a contiguous row or column

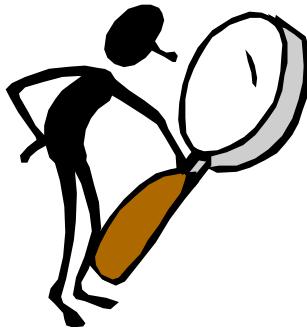
1. Click a cell below or to the right of the numbers for which you want to find the average.
2. Click the arrow next to **AutoSum** on the **Standard toolbar**, and then click **Average** and press ENTER.

Search Results

30 results from Office Online

- 1. **AVERAGE**  
Help > Statistical Functions
- 2. **Find or replace text and numbers on a worksheet**  
Help > Copying and Moving Data
- 3. **Calculate the average of a group of numbers**  
Help > Math Formulas

### 3.3.4 Statistical Tools – taking a closer look at your data

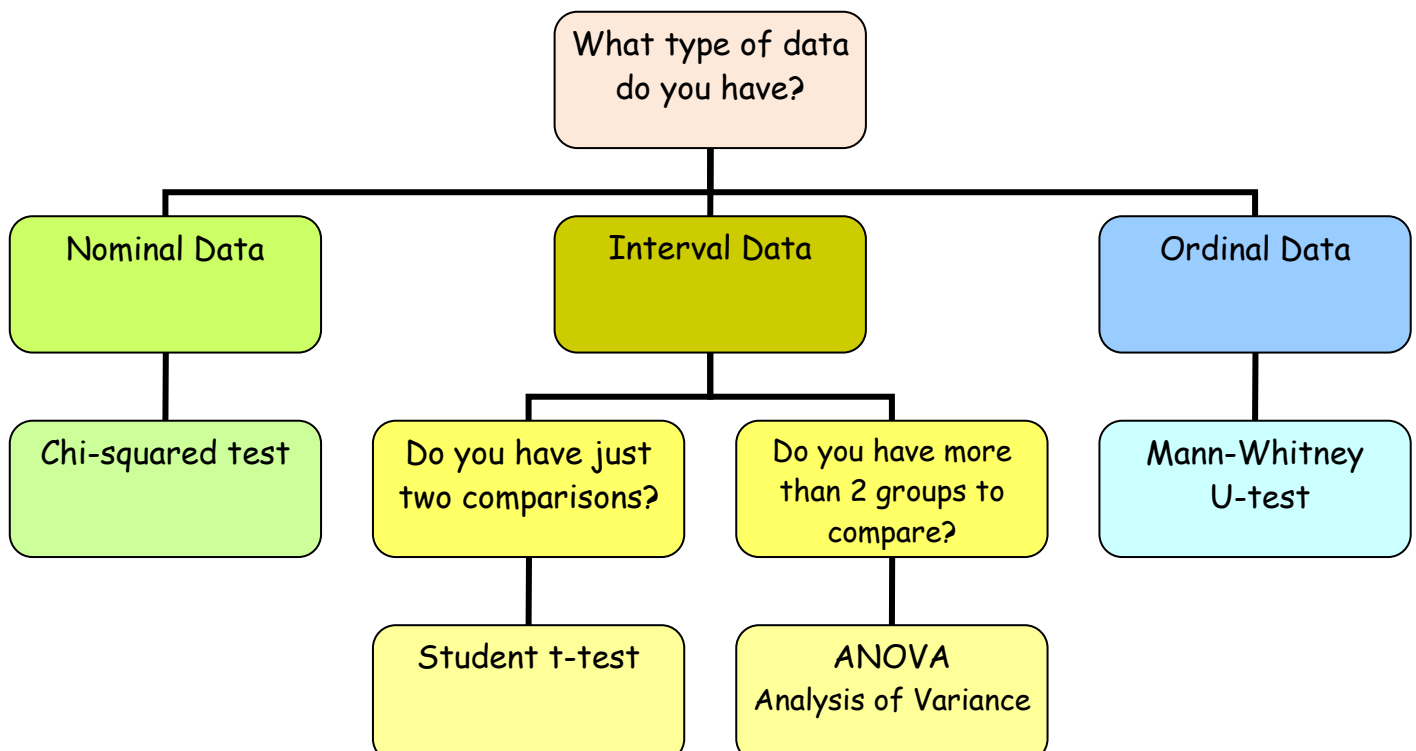


Statistics can be very useful tools to examine the reliability of your data.

Steps in the process.....

- Identify what type of data you have
- Identify which test to use
- Learn how to use the test by following an example

Nominal Data	Interval Data	Ordinal Data
<ul style="list-style-type: none"> <li>• This data is in categories – it is either or data.</li> <li>• It is sometimes called categorical data.</li> </ul>	<ul style="list-style-type: none"> <li>• This data involves accurate measurements of a variable</li> </ul>	<ul style="list-style-type: none"> <li>• Some variables, such as emotions, cannot be measured accurately; the data obtained is called ordinal data.</li> </ul>
<b>Examples:</b> <ul style="list-style-type: none"> <li>• Eye colour in humans</li> <li>• Flower colour in pea plants</li> <li>• Human blood types.....</li> </ul>	<b>Examples:</b> <ul style="list-style-type: none"> <li>• Length of leaves on a plant</li> <li>• Mass of mice over a period of 6 weeks</li> <li>• Rate of photosynthesis for a plant</li> </ul>	<b>Examples:</b> <ul style="list-style-type: none"> <li>• Number of acts of aggression or submission displayed by an animal in a social group.</li> </ul>



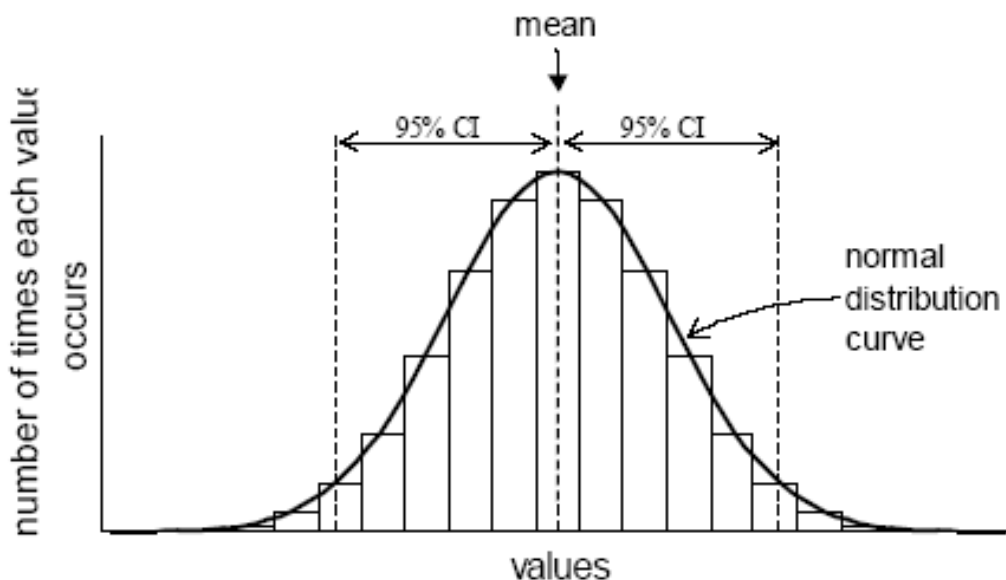
What do statistics tell us?

### Simple Statistics – Means and confidence intervals

When you did your experiments, you took multiple samples to try to ensure that your data was reliable. Were the results consistent? If the results are consistent, we can be more confident that our data is reliable and our conclusions are sound.

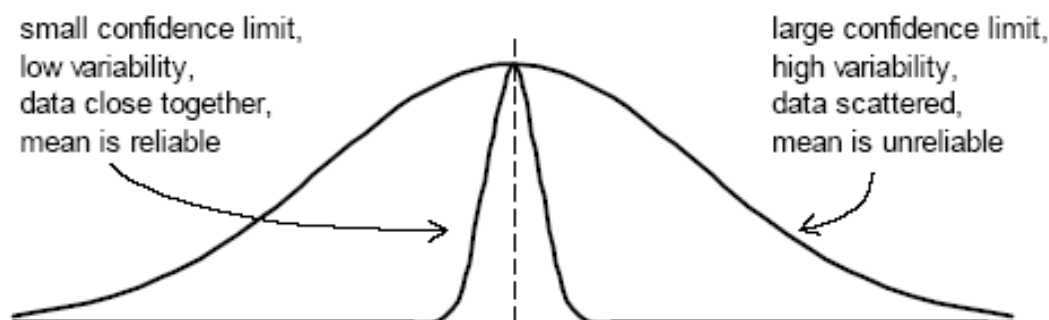
We can calculate the **mean** value in your data. We would like all the data to be close together.

We can calculate the **95% confidence interval** to see how much spread there is in the data. We would like all the data to be close to the mean.



<http://www.heckgrammar.kirklees.sch.uk/content/departments/science/biology/merlin.htm>

The smaller the 95% confidence interval is, the more reliable the mean is.



## **Interpreting statistics:**

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- The statistical tests are used to test your null hypothesis – that there is no difference between sets of data or there is no association between data.
- Each test will return a P-value – which is the probability that the null hypothesis is true.

### **Making sense of the p value**

- The P-value is traditionally expressed as a number between 0 (impossible) and 1 (certain).
- You will be using excel which can convert the number to a percentage, 0 % ( impossible) - 100% (certain).
- The lower the probability, the less likely it is that the null hypothesis is true. In biology we usually look for a P-value of 0.05 or 5%

### **Accept or reject?**

- If  $P < 5\%$  (0.05) – reject the null hypothesis
- This means that there IS a significant difference or association in the data. ☒
- If  $P \geq 5\%$  (0.05) – accept the null hypothesis
- This means that there IS NO significant difference or association in the data. ☐

## Student t-test

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- This test is used to compare two sets of interval data.
- The means of the data are calculated.
- The null hypothesis is that there is no difference between the means of the two sets
- Data is either matched (paired) or unmatched (unpaired)
  - Matched data is from data sets where there is a correlation between the data. E.g. you may be looking at before and after data; tests on the same individual in different situations; tests that are matched – e.g. people who are left handed, the same age etc.
  - Unmatched data is when there is not a relationship between the two sets of data e.g. different individuals, different population groups etc

Record all data on an excel spread sheet: On the “Statistics examples” spreadsheet find the worksheet labelled “**t-test paired**”

### *Effect of Cell Phone Use on Ability of Experienced Drivers to Identify Hazards in Driver Simulation Test*

Subject	Males without Cell phone (%)	Males with cell phone (%)
1	83.63	83.33
2	81.9	82.22
3	52.66	17
4	86.65	67.06
5	92.22	66.33
6	83	66
<b>Mean</b>	<b>80.010</b>	<b>63.657</b>
<b>95% CI</b>	<b>14.59</b>	<b>25.42</b>
<b>t-test</b>	<b>3.72%</b>	

### To calculate the mean:

Click on the cell where you want to formula to go.  
Click on the insert function tool.

Type in the name of the formula you wish to use.  
Select the data that you wish to average. In this case B11:B16

Click on return.

### For 95% confidence interval type into the cell:

=CI(B11:B16,0.05) and click on return

Because the two data sets comparing the same subjects in different situations they are paired

### For the t-test type into the cell:

=TTESTP(B11:B16,C11:C16) and press return

This is paired data because it was the same male subjects – with and without the cell phones.

What does this all mean?

Hypothesis: That use of a cell phone will reduce the ability of experienced male drivers to observe hazards in a driver simulation test

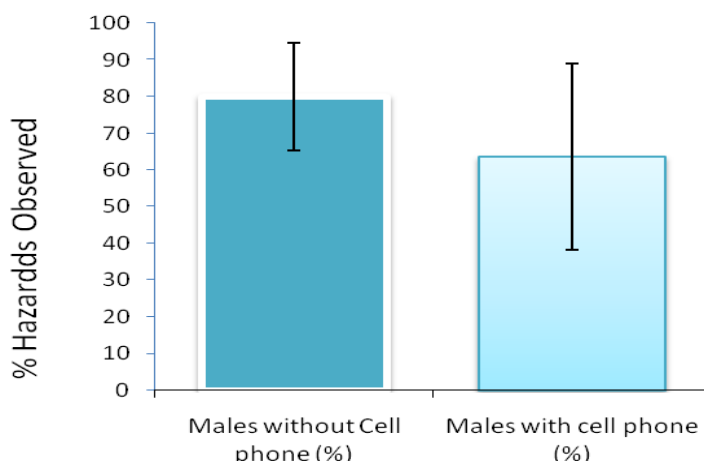
Null Hypothesis: That use of a cell phone will not affect the ability of experienced male drivers to observe hazards in a driver simulation tests

We carried out a paired t-test to see if the mean of each set of data was similar or different.

It was paired because we were testing the same males – with and without cell phones.

The t-test returned a P value of 3.72%. This is less than 5% ( $P < 5\%$ ) so we reject the null hypothesis and conclude that the use of a cell phone does reduce the ability of experienced male drivers to observe road hazards in a driver simulation test.

Effect of Cell Phone Use on Ability of Experienced Drivers to Identify Hazards in Driver Simulation Test



Record all data on an excel spread sheet: On the “Statistics examples” spreadsheet find the worksheet labelled “t-test unpaired”

<b>Effect of reduced soil fertiliser content on <i>B. rapa</i> dry mass (g) after 14 days growth</b>		
<b>Plant set</b>	<b>Standard Fertiliser</b>	<b>Reduced fertiliser</b>
1	0.106	0.102
2	0.095	0.095
3	0.114	0.0897
4	0.11	0.0795
5	0.113	0.112
6	0.092	0.102
7	0.156	0.097
8	0.124	0.095
9	0.116	0.104
10	0.108	0.113
11	0.098	0.102
12	0.102	0.096
13	0.108	
14	0.12	
<b>Mean</b>	<b>0.112</b>	<b>0.099</b>
<b>95% CI</b>	<b>0.91%</b>	<b>0.58%</b>
<b>t-test</b>	<b>2.23%</b>	

#### To calculate the mean:

Click on the cell where you want to formula to go. Click on the insert function tool.

Type in the name of the formula you wish to use. Select the data that you wish to average. In this case B11:B24 Click on return.

**For 95% confidence interval type into the cell:**  
=CI(B11:B24,0.05) and click on return

Because the two data sets are uneven - this is an unpaired t-test

**For the t-test type into the cell:**  
=TTESTP(B11:B24,C11:C22) and press return

This is unpaired data because it was not the same plants grown with different fertiliser rates.

#### What does this all mean?

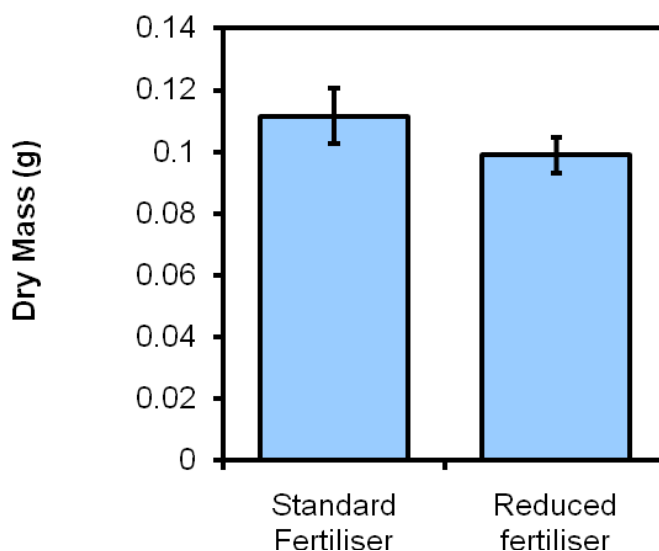
Hypothesis: That reduced fertilised will reduce the total dry mass of the *B.rapa* plants after 14 days growth.

Null Hypothesis That reduced fertiliser will have no effect on the total dry mass of the *B.rapa* plants after 14 days growth.

We carried out an unpaired t-test to see if the mean of each set of data was similar or different.

It was unpaired because we have 14 plants in one trial and 12 in the other. The t-test returned a P value of 2.23%. This is less than 5% ( $P < 5\%$ ) so we reject the null hypothesis and conclude that the reduced fertilise did have an effect on the total dry mass of the plants after 14 days.

Effect of reduce fertiliser on dry mass of *Brassica rapa* after 14 days growth





## Analysis of Variance - ANOVA

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- This test is used to look for associations in multiple sets of data.
- The data should be in a normal distribution and there should be at least 10 replications.
- The means of the data are calculated.
- The null hypothesis is that there is no associations between the data sets – the sets of data would have the same means if the null hypothesis was to be true.

[Record all data on an excel spread sheet:](#) On the sheet find the worksheet labelled ANOVA

Effect of light colour on <i>B. rapa</i> dry mass (g) after 14 days growth				
	Light Colour / Wavelength (nm)			
Plant	White Light	480nm	560nm	670nm
1	0.106	0.103	0.098	0.102
2	0.095	0.087	0.068	0.095
3	0.114	0.0965	0.047	0.0897
4	0.11	0.108	0.102	0.0795
5	0.113	0.117	0.086	0.112
6	0.092	0.105	0.104	0.102
7	0.156	0.097	0.076	0.097
8	0.124	0.108	0.093	0.095
9	0.116	0.079	0.087	0.104
10	0.108	0.092	0.058	0.113
11	0.098	0.102	0.101	0.102
12	0.102	0.105	0.097	0.096
13	0.108	0.117	0.087	
14	0.12	0.109		
<b>Mean</b>	<b>0.112</b>	<b>0.102</b>	<b>0.085</b>	<b>0.099</b>
<b>95% CI</b>	<b>0.91%</b>	<b>0.62%</b>	<b>1.08%</b>	<b>0.58%</b>
<b>ANOVA</b>	<b>0.01%</b>			

To calculate the mean:  
Click on the cell where you want to formula to go.  
Click on the insert function tool.  
Type in the name of the formula you wish to use.  
Select the data that you wish to average. In this case B11:B24  
Click on return.  
For 95% confidence interval type into the cell:  
=CI(B11:B24,0.05) and click on return

For the ANOVA type into the cell:  
=ANOVA(B10:E23) and press return

What does this all mean?

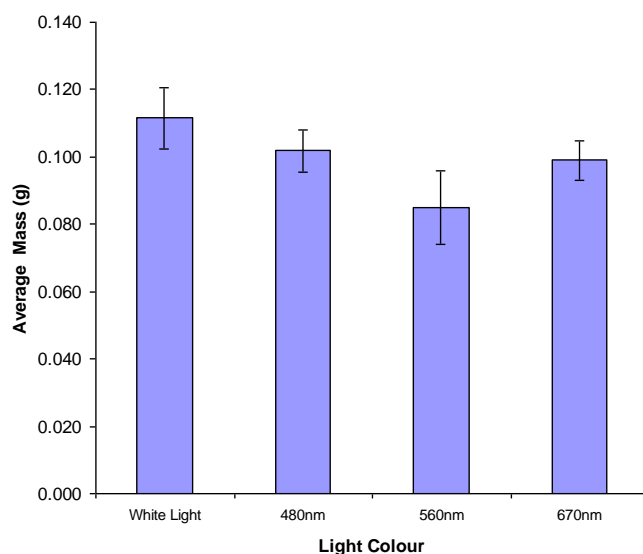
Hypothesis: That the colour of the light that the plants are grown in will affect the total dry mass at the end of 14 days growth.

Null Hypothesis: That the colour of the light that the plants are grown in will not affect the total dry mass at the end of 14 days growth

Because two have more than two sets of data we have used an ANOVA

The ANOVA returned a P value of 0.01%. This is less than 5% ( $P < 5\%$ ) so we reject the null hypothesis and conclude that the colour of the light did have an effect on the total dry mass at the end of 14 days growth (i.e. the rate of growth of the plant).

Effect of Light Colour on dry mass of *B.rapa* after 14 days growth



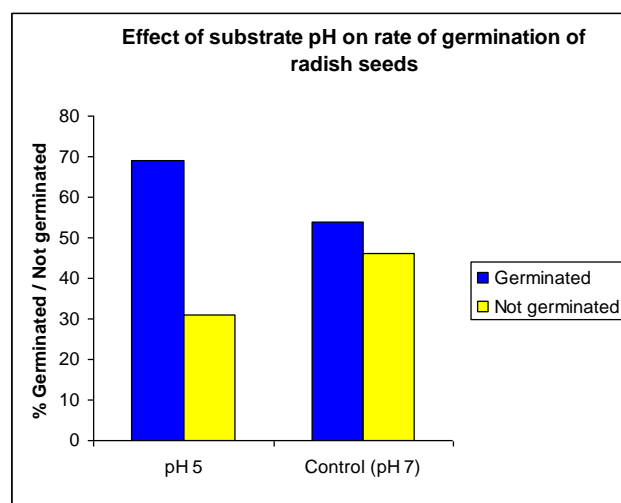
## Chi-squared test

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- This test is used to compare two sets of nominal data.
- The means of the data are calculated.
- The null hypothesis is that there is no difference between the means of the two sets.

[Record all data on an excel spread sheet:](#) On the sheet find the worksheet labelled Chi-squared

Effect of soil pH on germination rate of radish seeds		
Germination rate (%)		
Category	pH 5	Control (pH 7)
Germinated	69	54
Not germinated	31	46
Total	100	100
<b>X<sup>2</sup> test</b>	<b>0.26%</b>	



Chi squared is used to test whether there is a significant difference between two sets of data. Chi squared is used when you have frequency data rather than measurements. Chi squared compared the observed frequency with an expected frequency. In the examples below, you would expect there to be equal numbers of male and female offspring in the 1st generation - so the expected would be 50% of each. In the germination rate example, you would expect there to be equal numbers of seed germinated in both conditions if the null hypothesis was true.

To calculate the total  
Click on the cell where you want to formula to go.

Click on the insert function tool.  
Type in the name of the formula you wish to use - in this case SUM  
Select the data that you wish to sum - in this case B8:B9  
Click on return.  
For chi squared value - type in =CHITEST(B8:B9,C8:C9)

What does this all mean?

Null Hypothesis: That changing the soil pH not affect germination rates - they will be equal in both pH conditions.

The Chi Squared test returned a P value of 0.26%. This is less than 5% ( $P < 5\%$ ) so we reject the null hypothesis and conclude that changing the pH of the soil did affect germination rates in radish seeds.

### 3.4 Writing your conclusion, discussion and evaluation [Return to contents page](#)

Conclusion and Discussion	This is a statement of <b>conclusion</b> relating the findings of the investigation back to the aim and hypothesis, followed by an <b>in-depth discussion</b> of the biological significance of the results and how they relate to the ecological niche of the organism. If your results do not support known biological facts or theories, you should discuss this discrepancy.
Evaluation	An outline of the <b>assumptions</b> that were made in the investigation; problems encountered and a critical evaluation of the effect of these in the investigation. This includes analysis of <ul style="list-style-type: none"><li>• <b>limitations</b> of the investigation</li><li>• potential sources of error</li><li>• the level of <b>validity</b> of the method</li><li>• <b>reliability</b> of the data and statistical analysis</li><li>• The potential for further investigation that may be appropriate</li></ul>

### 3.5 Does your original method write up need editing?

Check that your original method is still accurate. Have you made changes? If so this needs to be edited to show the actual method that you undertook. You may discuss the reasons for the changes in your evaluation if this is appropriate.

### 3.6 Writing your introduction [Return to contents page](#)

Introduction	An outline of the background information and observations, which led to the formation of your hypothesis. This section should explain the <b>biological concepts</b> relating to the <b>hypothesis</b> and <b>describe the events</b> that would be <b>expected</b> in the investigation as a result of your knowledge of biological concepts. You should <b>reference literature</b> relating to the topic of investigation in this section to establish the extent to which you have researched the topic prior to starting your investigation. This should be written in third person.
--------------	---

### 3.7 Writing your abstract [Return to contents page](#)

An abstract is a short summary (10 – 15 lines) outlining the **purpose** of the project and the **key findings**.

Here is an example of an abstract:

*The purpose of this investigation was to research whether the cleansing of pheromones from Hemideina thoracica's habitat would affect its activity during the night. I left the weta in uncleaned boxes for several days, monitoring their activity, then cleaned the enclosure and removed faeces every day to see if each weta's activity changed. From this investigation I found that cleaning the enclosure of a weta did have an effect on its activity. The wetas, on average, began and finished their activity earlier, and had a shorter period of activity. This appeared to be as a direct result of the removal of pheromones.*

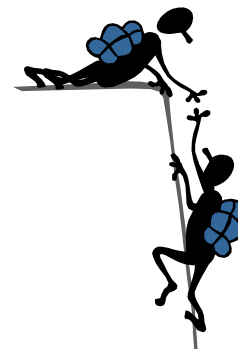
### 3.8 Writing your acknowledgement

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It is important that you acknowledge all the people who have helped in any way towards you achieving this project. Scientists work in teams – so although this is your project, we would expect

you to have had advice and help to achieve your goals.

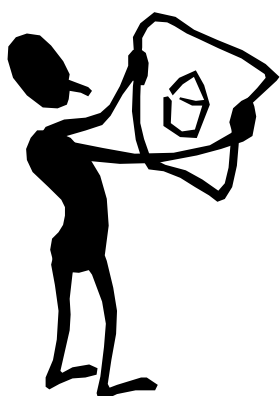
Please use the format provided to record your acknowledgements.



Name	Position or relationship	How they assisted me.
	Mentor - University of Auckland	
	Teacher	
	Teacher - Liggins Institute	Guidance in my investigation
	Technician - Liggins Institute	

### 3.9 PROOF READING!

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Finally..... you **MUST** get someone else to proof read your work!

You teachers and mentors can give you advice along the way in terms of the content of your report – send your best drafts of each section for checking.....

***BUT – at the end, get someone reliable to do a final proof read for you – your parents, older siblings, cousins, aunts – someone who you know is going to be fussy about checking for spelling, grammar and clarity of writing.***



## Section Three:      **Appendices**

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## Schools' Animal Ethics Committee 2010 Student Form

### Application for Ethical Approval for an Investigation/Project Involving Live Animals

**Project Title:** .....

**Student Name:** .....

**School:** .....

**Year Level:**.....

**Date of application**.....

**Intended start date of project:** ..... **Intended finish date of project** .....

<b>Home</b>	<b>School</b>
Name of Parent/Caregiver Supervisor	Name of Teacher Supervisor:
Address:	Address:
Phone:	Phone:
Email:	Email:

You must apply before beginning your work. Please tick at which of the 2010 Animal Ethics Committee meetings you would like your application to be considered at and ensure your application is submitted at least 1 week before that:

☐ 10 March

☐ 14 April

☐ 12 May

☐ 9 June

☐ 7 July

☐ 11 August

☐ 8 September

☐ 13 October

☐ 10

November

If there are good reasons the Committee may consider projects at other times but you will have explain why (not just failing to meet the above meeting times).

1. Does your project involve live animals? ☐ Yes (go to Q 2) ☐ No (approval not required)

A **live animal** is a: mammal, bird, reptile, amphibian, fish (bony or cartilaginous), octopus, squid, crab, lobster, or crayfish (including freshwater crayfish); mammalian foetus, avian or reptilian pre-hatched young that is in the last half of gestation or development; or any marsupial pouch young.

2. List the type and total number of animals that you will use:

Animal .....

Number in your project.....

*Note: If your project involves catching, killing, or obtaining the eggs, dead bodies or parts, of any native mammals, birds (except game birds), reptiles or amphibians, or bush and ground wetas, ground or carab beetles, Nelson cave spiders, snails, black and red coral, or spotted black groper, you need to also get a permit from the Department of Conservation ([www.doc.govt.nz/](http://www.doc.govt.nz/)). A permit may also be required to remove native species from National Parks or Reserves.*

3. Aim – briefly explain what are you trying to find out or what are you trying to develop?

4. **Risks to animals:** I have identified the following risks to the health or well-being of the animal(s) as a result of the procedures: *You are required to talk with some-one who has experience or is qualified in this area to make sure that you identify all actual and potential risks to the animal and/or to yourself.*

- 
- 
- 

Who is the experienced or qualified person you have discussed these risks and how to minimise them ..... with (e.g. your teacher, a farmer, animal breeder, or a vet)?

Name.....

Experience or qualifications.....

What advice or answers were you given?

Should any of these risks occur and cause irritation or harm to the animal(s), then what will you do?

You **must** answer all the following questions, or attach a copy of your project plan ensuring it includes all the information asked for in Questions 5-9.

**5. Outline what are you going to do and how will you do it?**

- What will you do with/to the animals in your project?
- For how long will the animals be used?
- What will you measure, observe or record to report your findings?
- If your investigation does not go as you planned, what will you do?

**6. Where will you obtain the animals from?** ☐ pet from home ☐ animal from a farm  
☐ elsewhere (please explain where) .....

**7. Where will you keep the animals (please tick one):** ☐ at school ☐ at home  
☐ elsewhere (please explain where) .....

**8. If your project involves caging or housing an animal(s) briefly describe**

- how will they be caged or housed  
.....
- how and when will you provide food and water  
.....
- how you will keep the housing clean  
.....
- how you will care for them in the weekends  
.....
- how you will care for any animals that become unwell:  
.....



**9. At the end of your project what will happen to the animals** (please tick one):

☐ kept in, or returned to, their original environment

☐ returned to a similar environment (please explain where)

.....

☐ kept elsewhere (please explain where)

.....

☐ if the animals need to be killed at the end of the project, explain why this is necessary, and how and who will do this humanely?

.....

**Either email this form to [animalethicscommittee@nzase.org.nz](mailto:animalethicscommittee@nzase.org.nz) or fill it in using a black or blue pen and post it to NZASE Animal Ethics Committee, PO Box 10122, WELLINGTON 6143.**

*After your project has been approved and completed, you will also have to fill out a simple Statistics Form about what animals were used, how many, and what happened to them after the project. This information is required by the Ministry of Agriculture and Forestry who monitor Animal Ethics Committees.*

*After your project has been approved, if you need to change the design including the source, type and numbers of animals or what you do to them, and any materials, housing or foods used, you must seek approval from the Animal Ethics Committee to modify your project.*

---

**Hints**

- *Diagrams or photographs of any caging or devices used or planned for development will be a help to the Committee to understand and approve your project.*
- *If you plan to use large numbers of animals, you should consider whether a smaller number would be enough.*
- *For information on how to look after the animals in your project see the booklet "Caring for Animals" (available at your school or at [http://www.tki.org.nz/r/science/caring\\_for\\_animals/](http://www.tki.org.nz/r/science/caring_for_animals/)).*

---

**For NZASE Schools' AEC use only**

**File Number**

**Approval**      Granted / Provisional / Pending / Declined .....

**Signature** .....

**Designation** .....

**Date of Approval:**      /      /20

**Project monitored**   Y/N

**Grade**

.....

**Additional changes** Withdrawn / Modified / Revoked ..... /    /20

**Animal Statistics Return Form Completed**..... /    /20

## LENScience Application for Human Ethical Review

**APPLICATION FOR ETHICAL REVIEW OF SCHOOL PROJECTS OR EXPERIMENTS INVOLVING HUMAN SUBJECTS CARRIED OUT THROUGH LENSscience PROGRAMMES**

1. Project Title:

2. Name of student:

Year:

School:

Name of student:

Year:

School:

3. Reason project is to be done:

CREST award

☐

Science and Technology Fair

☐

As part of school studies in (enter subject):

Other reason (state):

4. Supervising Adults

Home	School Liaison Teacher	LENScience Teacher
Name of Parent/Caregiver:	Name:	Name:
Signature:	Signature:	Signature:
Phone:	Phone:	Phone:
Email:	Email:	Email:

5. Project aims: What information do you expect to find out from doing your project?

6. Selection of Participants:

- What sort of participants will you be asking to take part in your project? \_\_\_\_\_  
 (Select from Classmates / Family members / General public / Children / Other)  
 If you have selected "Other" briefly describe this group.
- How many participants do you plan to have in your project? \_\_\_\_\_
- What ages or age range will be used? \_\_\_\_\_
- If any participants are under 16 years of age will you have you written consent from their parent/caregivers? Yes / No

7. Experimental procedure: **Attach a copy of your method.**

Please ensure the following are covered:

- Describe in detail what you intend to do to or with the people who will be your participants.
- If you intend to ask them to take any medicines or food, or to apply any substance to any part of their body, or to undergo any physical or medical tests, you must give full details (what, how much, how often etc)

## 8. Risks

- What risks are there to your participants from the procedures you are going to use?
  - Have you discussed these risks and how to minimise them with a qualified person such as a doctor or nurse? Yes / No
- If “yes”, what is that person’s name and qualification?

## 9. Informed Consent

- Will you tell the participants:
  - the purpose of your research? Yes / No
  - clearly what you want them to do or how they are to be used? Yes / No
  - what risks (if any) there may be to them? Yes / No
  - they can refuse to participate or withdraw from the experiment at any time? Yes / No
  - they can ask you questions at any time? Yes / No
- Have you given the participants the above information in written form? Yes / No

## 10. Privacy and Confidentiality

- Will you be asking your participants for any private or confidential information (such as their medical history, income, etc)? Yes / No
- If “yes”, exactly what will you be asking them
- If you will be making a video or a tape recording of your participants, will the tapes be erased at the end of your project? Yes / No
  - Will you tell your participants the results of your study? Yes / No
  - Will your report leave out their names, to protect their privacy? Yes / No

Signature of student(s)

Name of student: Signature: \_\_\_\_\_

Name of student: Signature: \_\_\_\_\_

Date:

---

This section for use by Liggins Education Network for Science Human Ethics Review Committee

This project is - Approved ☐ Subject to: .....

or - Not approved ☐ Because: .....

Signed .....

Date: .....

on behalf of the Ethics

Committee.

## Appendix III

### Exemplar Participant Information Letter

Project title:

Participant Information Sheet

Your Name:

Your School:

Date.....

Dear Participant,

I am a Year XX student at XXXXXXXXXX who has been selected to participate in the Student - Scientist Mentor Programme at the Liggins Institute, University of Auckland. As part of the programme I am undertaking a CREST project in which I am hoping to find out

.....

I am asking you to be a participant in my research. This will involve you in the following.

- You will be required to answer an anonymous questionnaire which should take you no more than 15 minutes.
- You will be required to take a cognitive recall test and a co-ordination test which should take no more than 10 minutes
- After this your pulse rate will be taken
- You will then be asked to consume either 250mL of coffee or 250mL of

.....

The information that I collect will be anonymous. This means that when I report on my results, you will not be identified in the report. The results of my investigation will be presented in a report to the Auckland Science Fair and to staff at the Liggins Institute and XXXXXXXX. I may also be asked to present a seminar to my peers.

You may withdraw from the project at any time and are under no obligation to participate if you do not wish to. The raw data that I collect will be kept confidential.

If you have any queries regarding participation in this project, you can contact me at

.....

Alternately, you may contact my teacher mentor, Helen Mora, [h.mora@auckland.ac.nz](mailto:h.mora@auckland.ac.nz)

Thank you for your help in this project.

Yours sincerely

## Exemplar Participant Information Form

### Project Title

Researcher: xxxxxxxxxxxxxxxx

School: xxxxxxxxxxxxxxxxxxxxxxxx

Supervisors: e.g. Ms Helen Mora – Liggins Institute, University of Auckland  
Sarah Hopkins – PhD candidate Liggins Institute, University of Auckland  
Mr Bal Karan – Mount Roskill Grammar School

I have read the participant information sheet and been given the opportunity to ask questions about this study and have them answered.

I understand that I will be involved in a study that requires me to participate in the tests outlined in the letter that I have been given.

I understand that: this is an example .....

- This will involve me in the tests once a week for 3 weeks
- The test results are anonymous and no person will be identified in the research report
- I can withdraw from the tests at any stage if I choose to
- The data will be kept in a safe and secure place by Joseph Windsor
- I will not receive any payment as a result of my participation in this project

I have shown the parent / caregiver information letter to my parent / caregiver and they have agreed to my participation and signed the parental consent letter.

I therefore give my informed consent to participate in the “type the name of your project here” project by taking part in the tests.

Name of Student: \_\_\_\_\_

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

Date of Birth: \_\_\_\_\_

## Appendix IV

### Exemplar Parental Consent Letter

Project title:

Your Name:

Your School:

Date:

Dear Parent,

I am a Year XX student at XXXXXXXXXX who has been selected to participate in the Student - Scientist Mentor Programme at the Liggins Institute, University of Auckland. As part of the programme I am undertaking a CREST project in which I am hoping to find out

.....

If the participants are under 16 years of age, as well as the young person agreeing, I am required to obtain the parent or guardians permission.

My research will involve (name of participant) in the following.

- They will be required to answer an anonymous questionnaire which should take you no more than 15 minutes.
- They will be required to take a cognitive recall test and a co-ordination test which should take no more than 10 minutes
- After this their pulse rate will be taken
- They will then be asked to consume either 250mL of coffee or 250mL of

.....

The information that I collect will be anonymous. This means that when I report on my results, (name of participant) will not be identified in the report. The results of my investigation will be presented in a report to the Auckland Science Fair and to staff at the Liggins Institute and (name of school). I may also be asked to present a seminar to my peers.

(Name of participant) can withdraw from the project at any time and are under no obligation to participate if they do not wish to. The raw data that I collect will be kept confidential.

If you have any queries regarding participation in this project, you can contact me at

.....

Alternately, you may contact my teacher mentor, Jacquie Bay [j.bay@auckland.ac.nz](mailto:j.bay@auckland.ac.nz)

If you do give permission for ..... to participate in my project could you please complete and the attached form and return to me at school by .....

Yours sincerely

## Parental Consent Form

# Concentration and Exercise

Researcher: xxxxxxxxxxxxxxxxxxxx

School: xxxxxxxxxxxxxxxxxxxxxxxxxxxx

Supervisors: Ms Helen Mora – Liggins Institute, University of Auckland  
Sarah Hopkins – PhD candidate, Liggins Institute, University of Auckland  
Mr Bal Karan – Mount Roskill Grammar School

I have read the parent consent letter and been given the opportunity to ask questions about this study and have them answered.

I understand that \_\_\_\_\_ will be involved in a study that requires him/her to participate in the tests outlined in the letter that I have been given.

I understand that:

- the test results are anonymous and no person will be identified in the research report
- participants can withdraw from the tests at any stage if they choose to
- the data will be kept in a safe and secure place by Joseph Windsor
- no payment will be given as a result of participation in this project

I therefore give my informed consent for \_\_\_\_\_ to participate in the “xxxxxxxxxxxxxxxxxxxxxx” project by taking part in the tests.

Name of Student: \_\_\_\_\_

Name of Parent / Caregiver: \_\_\_\_\_

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

## Appendix V

### Exemplar School Consent Letter

Insert name(s)  
Year Level  
School  
Student - Scientist Mentor Programme  
Liggins Institute

Date

To the Principal  
School  
Address  
Address  
Address

#### Principal / School Information

#### Topic Title

Dear (Principal name)

We are year 10 students at (school name) who have been selected to participate in the Student - Scientist Mentor Programme at the Liggins Institute, University of Auckland. As part of the programme we are undertaking a CREST project in which we are hoping to find out (purpose of project).

Whilst doing this investigation, we would like to survey ten, volunteer year 10 students and ten volunteer year 13 students from a co-ed school. .... *explain exactly what you are intending to do*

Attached is a copy of the participant information form and copy of the questionnaire.....

These have been developed by us with assistance from our mentors, xxxxxxxxxxxxxx and xxxxxxxxxxxxxx. They have been submitted for Human Ethics approval to the Northern Regional Ethics Committee as per the requirements of CREST. A teacher or scientist will be present with us when we conduct the questionnaires with the student volunteers.

All information that is gathered will be kept confidential and all of the surveys will be kept anonymous. In our reporting, we will not state the names of the three schools that have participated in the investigation. The final result will be shown at a presentation day, that will be held at the Liggins Institute that you are most welcome to attend, and at the Auckland Science Fair.



We will send a report of the findings to the participants.

If you agree for this research to be undertaken, please fill out the attached consent form and send it to back to us. Information and consent forms will then be provided to the students participating in our research.

If you have any queries regarding participation in this project, you can contact us at Student names and email addresses

Alternately, you may contact our teacher mentor, *(name of LENS teacher and their email)*

Thank you for your help in this project.

Yours sincerely

(Student names)

(Student names)

[Return to Human Ethics](#)  
[Return to Student Instructions](#)

# Project title – type here

## School Consent Form

I have read the school information form and been given the opportunity to ask questions about this study and have them answered.

I understand the students: **modify this example to suit your project.....**

- The students will be involved in 3 test days, at 35minutes per day over a period of three weeks
- The school and/or students taking part in this research have the right to withdraw at any stage during the study;
- Data will be identified by code and kept secure;
- The final research report will not refer to individual participants, or schools that participated in the study;
- I will receive summary of the final report at the conclusion of the project.
- A teacher or scientist will be present with the students when they come to do the questionnaires at the school;
- A teacher or scientist will be present as observers when the students do the interviews.

I therefore give my informed consent for students to take part in this research project.

Name:.....

Position:.....

School:.....

Signed:.....Dated:.....

## Appendix VI

### Exemplar Student Plan

#### STUDENT A:

##### Aim:

To investigate the effect of soil salinity on plant growth rates and health.

##### Hypotheses:

That plants subjected to levels of salinity at 250mmol and above will not survive.

That plants subjected to increasing levels of salinity above normal soil salinity levels will show deterioration in leaf health such as burnt leaves, shrivelling of leaves and reduction in chlorophyll content.

That growth rate (measured by height, leaf number and final dry mass of plants) will reduce as soil salinity increases.

That the expected timing of the life cycle of the plants may be altered by increasing soil salinity due to the stress that this may cause the plants. If the increased salinity is creating increase stress for the plant, we would expect the life cycle to speed up.

#### **Variables**

Independent variable: (What I will change)	Concentration of salt in the growth medium (vermiculite).
Dependent variable: (What I will measure to find the answer to my question)	<p>What I will measure:</p> <p>The following will be measured every 3 days for a period of 30 days:</p> <ul style="list-style-type: none"> <li>• Germination rate</li> <li>• Height of plants</li> <li>• Number of leaves on the plant</li> <li>• Condition of the leaves (colour and extent of burn damage as indicated by shrivelling)</li> <li>• Number of flowers produced</li> </ul> <p>The following will be measured at the end of the 30 day growth period plants at the end of 30 days growth:</p> <ul style="list-style-type: none"> <li>• Number of seeds</li> <li>• Chlorophyll content of the leaves</li> <li>• Dry mass of plants</li> </ul>
Controlled Variables: (What I will keep the same to make sure I have a fair test)	<p><b>What I will keep the same:</b></p> <ul style="list-style-type: none"> <li>• Growth conditions for all aspects other than salinity including pot size, growth medium, light regime, watering regime.</li> <li>• Pollination of the plants will occur via pipe cleaners, using cross pollination methods.</li> <li>• Seed stock - all from the same genetic parent plant, therefore we can assume that it is unlikely that there will be significant differences in the genetic makeup of the seeds.</li> </ul>

## Plan:

Use a series of bullet points to write your step by step plan.

Remember to make sure that you have enough repeats to be certain of your findings in the end.

1. Project preparation:
  - a. Write plan and submit feasibility study, plan and registration to CREST
2. Plant medium preparation (including salt solutions) :
  - a. Get Vermiculite.
  - b. Create my different salt solutions.
  - c. Put even amounts of Vermiculite into each plant pot.
3. Learning how to do tests:
  - a. Chlorophyll test.
  - b. Dry mass test.
4. Setting up the plants
  - a. Germinate my seeds in the fridge.
  - b. Plant the seeds in small pots.
  - c. Apply the salt solutions to the plants in the recommended way.
5. Monitoring plants:
  - a. Set up a diary record sheet in log book.
  - b. Record how the plants are progressing every 3 days
  - c. Record The following: How many seeds germinate, Height of the plant, The number of leaves on the plant, The condition of the leaves (are they burnt, are they shrivelled, are they discoloured etc), How long they take to reach the different stages in their life cycle
6. Testing chlorophyll levels
  - a. Take samples from both plants and weigh it to get same amount
  - b. Grind it with acetone and alcohol solution
  - c. Put the extract into a cuvette
  - d. Place into spectrometer
  - e. Measure at the end of the experiment
7. Testing dry mass
  - a. Take the whole plants and wash all the soil off
  - b. Place onto a tray and into the oven
  - c. Bake until it is dry
  - d. Check throughout the process to make sure the weight has dropped completely
  - e. Record the final weight of both plants
8. Data analysis:
  - a. Attend Liggins workshop on data analysis. During this day I hope to learn how to analyse my data using statistical methods.
  - b. Complete analysis of data
  - c. Write draft report; proof read and edit
  - d. Compile final report.
9. Write up report and prepare seminar presentation

## STUDENT B:

**Aim:** I aim to find out which food students should eat before school so they learn to the best of their ability. Using humans it would be too hard to monitor food intake, so I plan to use mice as my subject.

**Hypothesis:** I think that high protein, carbohydrate breakfasts combined with fruit (vitamins) will be the best for continuous learning throughout the day, as the energy is burnt off slowly (low GI). - Breakfast affects how you perform at 4:00pm! I think high sugar foods will be good for a short period of time instant energy but will burn off quickly. High fat I believe will be poor for learning and will provide little nutrition and will burn off.

### Variables

Independent variable (What I will change)	The type of food given to the mice at breakfast time (e.g. high carbohydrates, proteins, sugars, fats, cereals).	
Dependent variable (What I will measure to find the answer to my question)	What I will measure How well the mice learn under the influence of each food and also how they respond (how much exercise they do and how much of the food they eat.)	How I will measure this Using a watermaze. I will measure the time difference of the first time they found the stage and how fast they learn (decrease in time) the second time they complete the test. The mice will be tested for exercise with a wheel monitor and the food b.a.
Controlled Variables (What I will keep the same to make sure I have a fair test)	What I will keep the same <ul style="list-style-type: none"> <li>• The mice</li> <li>• The water maze</li> <li>• The amount of food.</li> <li>• Environment</li> <li>• Liquid in the watermaze.</li> <li>• Order</li> <li>• Amount of time they have to eat the food.</li> </ul>	How I will keep it the same. <ul style="list-style-type: none"> <li>• Use the same mice each time.</li> <li>• Use the same water maze set up the same way each time.</li> <li>• Weigh the food before I give it to them.</li> <li>• Have the same toys, cage, beds, shavings, etc.</li> <li>• Do the mice in order e.g. M1, M2, M3, M4.</li> <li>• Feed them breakfast at a designated time and do the test at a designated time.</li> </ul>

## Method:

1. Four female mice will be purchased from a pet store that are adults and all weighing within 10% of each other.
2. They will be housed in a rodent cage borrowed from the University of Auckland, which has a water bottle and food bowl. Hard saw dust will be used to line the bottom of the cage.
3. Care for the mice will be provided as follows:
  - a. In the initial period of housing, they will be fed mouse CHOW, supplied by the University of Auckland.
  - b. The mice will be given 50g of food and a bottleful of water for the day at 7:30am each morning
  - c. Soiled saw dust will be removed and replaced with fresh saw dust.
  - d. Once a week the cage will have a complete clean.
4. Testing period:
  - a. The morning of the experiment at 7:30am I will give the four mice the required food\*\* (50g). A water bottle will also be supplied.
  - b. In the afternoon at 4:00pm I will first test the mice.
    - i. First test: At approximately 4:00pm. Mouse 1 will be put in the water-maze\*. She will be timed on how long it took her to find the stage in the water-maze and her results recorded.
    - ii. The mouse will be dried and replaced in the cage while Mouse 2, 3 and 4 are tested.
    - iii. Second test: 30 minutes after she has done her first test she will repeat the test, she will be timed and the time recorded.
    - iv. The difference in her results will then be calculated and recorded.
    - v. The test will be repeated for mouse 2, mouse 3 and mouse 4.
    - vi. The mice will then have the next 6 days on the next diet and the tests were repeated on day 7.
    - vii. This process continued for 6 weeks - testing each of the foods in turn.
5. The results will be put in a table, averaged, graphed and compared. Statistical analysis will be conducted to identify whether any difference in performance that is observed is significant.

### **\*Water Maze**

Note to CREST - Once I have constructed the maze I will show details in my method. I have seen a rat water maze at the University of Auckland and taken advice on how to make a small version for mice.

### **\*\*Food used in testing:**

The following food sources will be used during testing, chosen following advice from by Mark Vickers and Dr Stuart Saigemen at the University of Auckland.

Food (note these diets were designed after advice from staff at the University of Auckland)	% Protein	% Fat	% Carbohydrate
CHOW (balanced)	18.90%	5%	57.33%
High fat diet (as provided by the University of Auckland)	20%	45%	35%
Froot Loops (high sugar)	6.4%	1.5% (0.5% saturated fat)	85.5% (41.5% sugars)
Rice crackers (high carbohydrate)	Currently unknown		
Nutri-grain (high protein and high carbohydrate)	21.9%	0.6% (0.1% saturated fat)	69.4% (32% sugars)
Protein bars (high protein)	Currently unknown		

**Post test period:**

After the testing the mice will be moved and will live in a science classroom at my school, Diocesan School for Girls. I have been promised by the Head of Department that they will be looked after well.

# Project Approval Form for Silver CREST

## Student Details

PLEASE PRINT CLEARLY

STUDENT NAME \_\_\_\_\_

YEAR \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## School Details

PLEASE PRINT CLEARLY

SCHOOL NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

TOWN/CITY \_\_\_\_\_

\_\_\_\_\_

EMAIL ADDRESS \_\_\_\_\_

SUPERVISING TEACHER \_\_\_\_\_

Supervising Teachers email address \_\_\_\_\_

## Consultant Details

NAME \_\_\_\_\_

OCCUPATION \_\_\_\_\_

EMPLOYMENT \_\_\_\_\_

PHONE \_\_\_\_\_

MOBILE \_\_\_\_\_

EMAIL ADDRESS \_\_\_\_\_

## Project Details

Need, opportunity or aim (this may be modified during the course of your project):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Action Plan

Attach a photocopy of your action plan from your log book.

Attach a copy of your calendar.

## For the Teacher

I have discussed this project with the student and believe it to be achievable.

Signed \_\_\_\_\_

TEACHER

DATE \_\_\_\_\_



Answer the following questions about your project as fully as you can.

**Question 1** Where did you get the idea for this project?

**Question 2** Explain how your project is a real life problem/need/opportunity.

**Question 3** What is your experience in this topic area?

**Question 4** What part of your project do you think will involve you using creative thinking and problem-solving skills?

**Question 5** What specialist equipment will you need to complete the project? Where are you going to get it from?

**Question 6** What are the key factors or variables you need to consider to achieve a successful outcome for your project?

**Question 7** What safety measures are you going to take to ensure your project will not cause harm to yourself or others, or to any living thing?

**Question 8** Are you doing this for: Science ☐, Technology ☐, NCEA ☐  
ACT ☐, Science Fair ☐ or Other ☐ .... (tick appropriate box)

**Question 9** Are you involving animals or people in your project? (circle) **Yes/No**

**If you said Yes you may require ethics approval. If you do need ethics approval, you must apply for and obtain approval before you begin your investigation.**

*Information on the animal ethics, the definition of an animal within the Animal Welfare Act, guidelines, examples and application forms can be found at <http://www.nzase.org.nz/ethics/> Investigations involving vertebrate animals (those with backbones) and crabs, lobster, crayfish, octopus and squid require **Animal Ethics** approval.*

*Discuss this with your teacher.*

*Investigations involving asking people to: taste different foods, smell or touch substances, take any medicines, drugs or other substances, apply any substance to their bodies, undergo any physical or medical tests, give any information of a personal, private or confidential nature and/or give information that could identify them will require **Human Ethics** approval. Further information on human ethics, guidelines, and application forms can be found at [http://www.rsnz.org/education/science\\_fairs/humanethicscode.php](http://www.rsnz.org/education/science_fairs/humanethicscode.php)*

*Discuss this with your teacher.*

*CREST NZ to complete...*

**Project Approver:**

Name: .....

Grade Awarded: .....

Approved ☐ Provisionally approved ☐ Not approved. Please resubmit ☐

Not Approved ☐.

**Comments.**